REPORT RESUMES

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THE RELATIONSHIP OF ANXIETY, CREATIVITY AND INTELLIGENCE TO SUCCESS IN LEARNING FROM PROGRAMED INSTRUCTION.

BY- RIPPLE, RICHARD E. O'REILLY, ROBERT P.
CORNELL UNIV., ITHACA, N.Y.

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SUCH CHARACTERISTICS AS ANXIETY, CREATIVITY, AND INTELLIGENCE WERE RELATED TO SUCCESS IN LEARNING FROM A REPRESENTATIVE PROGRAM OF THE LINEAR, CONSTRUCTED RESPONSE TYPE. A SAMPLE OF SIXTH GRADERS WAS ADMINISTERED TESTS PRIOR TO AND UPON COMPLETION OF A PROGRAMED UNIT ENTITLED "LATITUDE AND LONGITUDE." AN ANALYSIS OF THE EFFECTS OF LEARNING FROM PROGRAMED INSTRUCTIONAL MATERIALS ON THE VERBAL CREATIVITY SCORES OF THE SIXTH GRADERS WAS PURSUED SIMULTANEOUSLY WITH THE EVALUATION OF THE OTHER OBJECTIVES. AFTER AN INITIAL PHASE, IN WHICH THE RELIABILITY OF AN ANXIETY SCALE WAS VALIDATED, AN EXPERIMENTAL GROUP WAS PRESENTED WITH THE 2-WEEK PROGRAMED COURSE, AND A CONTROL GROUP WAS GIVEN TRADITIONAL INSTRUCTION OF THE SAME MATERIAL. FIVE ONE-WAY ANALYSES OF VARIANCE WERE COMPUTED COMPARING THE MEAN RESIDUAL GAINS MADE BY THE CLASSES IN THE PROGRAMED AND CONTROLLED CONDITIONS. NONE OF THE FIVE ANALYSES REVEALED A SIGNIFICANT DIFFERENCE BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS. (GD)

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THE RELATIONSHIP OF ANXIETY, CREATIVITY AND INTELLIGENCE TO SUCCESS IN LEARNING FROM PROGRAMED INSTRUCTION

Project No. 50567
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Richard E. Ripple and Robert P. O'Reilly

November 1966

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Cornell University

Ithaca, New York

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SECTION 1

INTRODUCTION

The general method or framework for instruction employed in most programed teaching units available for public school use is presumably derived from well established learning principles (49). Given a program which is constructed according to the relevant principles, it is expected that individuals with a relatively wide range of abilities will attain fairly similar achievement levels (31, 37). This expectation derives from the principles used in constructing the program, the empirical tests of the program on appropriate samples of learners, and recognition of the possibility that subsequent users of the program may proceed at their own rates of speed through the material.

Although one might wish that the learning conditions provided by programed instructional materials would solve the problem of individual differences in education, it is difficult to find any support for this proposition. Recent reviews of the research literature on programed learning (38, 48, 50) indicate that there has been little research on the effectiveness of programed materials for teaching learners with different characteristics. However, a few studies directed at this problem, suggest that this is an important direction for future research efforts in the field of programed instruction.

Moore, Smith and Teevan (37) cite several studies which support the conclusion that programed materials accentuate, rather than reduce individual differences. That is, given a heterogeneous group of individuals, the level of achievement attained at the end of a programed unit varies considerably from individual to individual. In their own research with college students, these authors found evidence indicating that achievement with programed instruction was in part a function of the level of difficulty of the program and the motivational characteristics of the S.

Gotkin (19) reports that the single most common criticism students make after using programed materials for a time, is that programed materials are boring. An informal comparative study of two types of English programs was attempted in order to determine students' reactions to different types of program structure. The programs were English 2600, a linear, constructed-response program which is an exemplar of the most widely used format in programed materials; and Markle's (36) Words program, a nontypical linear program which has a conversational style, emphasizes hypothesis making, and contains irrelevancies such as witticisms. Junior high school students of different ability levels who had experienced both programs were asked to comment on which program they preferred, with reasons for their preferences. The results, presented informally, indicated that the high ability students overwhelmingly preferred Markle's nontypical program, whereas the highly repetitive English 2600 was characterized by these students as boring. On the other hand, a large group of the low ability students preferred the certainty and repetition of English 2600 and considered it to be more interesting than the Words program.

In summarizing the present state of affairs with regard to meeting individual differences in programed instruction, Gotkin (19) concludes:

> ....there is little evidence that programs thus far written for classroom use really individualize classroom instruction. To pass through a single instructional path at one's own rate cannot be equated with the tutorial situation. To argue otherwise is to offer a naive notion of individualized instruction. By enabling students to proceed on their own and at their own pace, programed instruction does break the traditional lockstep of classroom procedure. In breaking the lockstep it makes an enormous stride forward in individualizing instruction. But that is only one dimension of individualization (p. 11).

Research on this problem may be approached in several ways, all of which may contribute varying amounts of information of both practical and theoretical significance. Assuming a theoretical orientation in all cases, the first and most simple approach might be to select one or more characteristics of learners and look at the relationships between these characteristics and achievement with a particular style of program. Another approach would be to select a given characteristic of the learner such as IQ level, and look at the achievement levels of learners with different IQ levels under different program structures. An even more complex approach would be to simultaneously vary the structure of the program along a number of dimensions for learners classified on the basis of several personality dimensions. The problem may be further complicated by introducing other important variables such as different types of program content.

The present authors decided to use the first and simpler model as an initial approach to this problem. It was also considered desirable to use an acceptable commercially-available program and to administer this program in a fashion closely resembling the normal usage of programs in the typical classroom. Using this approach it was reasoned that the results of the study might yield information which would be generalizable to a wider range of classrooms.

Rationale for the Study
An Analysis of the General Characteristics of Programed Materials

After examining a cross-section of programed materials, the writers identified the following characteristics which appeared to describe the style or structure of a wide range of programed materials. The account is purely descriptive. For convenience, this descriptive account will be subsequently referred to as the structure of the programed learning task.

Some Major Characteristics of the Programed Learning Task

1. Restrictiveness: the learner is required to respond either by thinking the answer or writing it out. The response allowed by the program is very limited and the learner's thinking is forced to conform severely to the requirements of the program.

2. Repetitiveness: the content of the lesson is arranged in a series of small steps which systematically repeat the essentials of the lesson.

3. Support: the learner knows immediately when his response is correct (he is reinforced continuously for correct responses).

4. Regulation: the learner controls some aspects of the learning situation (e.g., he works at his own speed; he works privately).

5. Organization: the content of the lesson is highly organized in a logical sequence of related facts, concepts and rules designed to lead the learner to criterion behavior.

6. Difficulty Level: the program is constructed so as to yield a low error rate. The content and much of the structure of the individual frame is determined empirically to insure that the program communicates successfully with a high percentage of Ss in the typical classroom.

7. Motivation: there is a relative absence of social, emotional and intellectual exchange between the learner, other students, and the teacher. The major source of motivation is presumably intrinsic to the learner and/or the program.

This descriptive account of the programed learning task suggests that its structure greatly accentuates certain aspects of teacher modes of presentation of subject matter (e.g., organization, repetition, etc.), while others are made less salient or are largely absent. However, unlike teachers in general, most programs available for use in the classroom are relatively more homogeneous from the point of view of the structure of the presentation of learning material.

Relationship of the Structure of the Programed Learning Task to Characteristics of the Learner

A review of the literature on personality led the investigators to focus on two personality characteristics which appeared to be related to learning via the structure of the programed learning task - creativity and anxiety.

The first of these learner characteristics, creativity, is conceptualized on the one hand as a type of thinking ability (22), and on the other hand as a personality disposition (1, 2, 33). As an ability, creative or divergent thinking is contrasted with other mental abilities such as IQ test performance (17, 41). For example, Guilford (22) has compared divergent or creative thinking with convergent thinking. He differentiates between the two as follows:

> In tests of convergent thinking there is almost always one conclusion or answer that is regarded as unique, and thinking is to be channeled or controlled in the direction of that answer .... In divergent thinking, on the other hand, there is much searching about or going off in various directions .... Divergent thinking ... [is] characterized as being less goal-bound. There is freedom to go off in different directions .... Rejecting the old solution and striking out in some new direction is necessary, and the resourceful organism will more probably succeed (22, pp. 6, 7, 9).

One of the more comprehensive studies of the personality of the creative person was performed by MacKinnon (33). A few findings derived from the administration of several well-known personality instruments to a group of creative architects are reviewed below:

1. The Welsh Figure Preference Test: On this test, the creative individuals showed a marked preference for complexity and assymetry. MacKinnon reasoned that creative persons are challenged by disordered multiplicity and have an unusual ability for the richness they are willing to experience.

2. The Myers-Briggs Type Indicator: On the sense perception versus intuitive perception scale, creative

individuals demonstrated preference for intuition which implies focusing on possibilities.

3. *The Strong Vocational Interest Blank*: From this test it was concluded that the creative architects were disinterested in details, cared more about meanings and implications and were unwilling to police either their own impulses and images or those of others.

4. *The California Psychological Inventory*: The profile of the creative person suggests that he is dominant, self-assured, not socially oriented, uninhibited, free from conventional restraints, highly motivated in independent activities, autonomous, outspoken and flexible.

5. *Self-Concept Report*: The creative architects desired to be more sensitive than they were, whereas the noncreative architects desired the incompatible attributes of simultaneously being more original and more self-disciplined.

Congruent with this line of thought, Barron (2) in his study of the "disposition toward originality", suggests that creative individuals prefer complexity and some degree of apparent imbalance in phenomena. Barron reasons that creative persons are disinclined to discipline their thoughts and actions and that through past conditioning, they have come to seek the more complex and disorganized problems in life. Anderson (1), in accord with MacKinnon's (33) results, obtained evidence suggesting that *impulsivity* is a characteristic of creative children in a study involving 320 seventh graders.

To the extent that available tests of creativity measure not only creative abilities, but also measure a general *disposition* toward creativity, then it might be expected that the creative individual would find the *structure* of the programed learning task incongruent with his needs and preferences. The restrictiveness, repetitiveness and extensive organization of the programed learning task would appear to conflict with such hypothesized characteristics of the creative person as his impulsiveness, his need for autonomy, and his needs for assymmetry and complexity.

Gotkin and Massa (20) performed an experimental study which provides some empirical support for this rationale. Eighteen gifted fourth graders and 25 gifted fifth graders completed a lesson a day for a two-month period in Markle's (36) *Words* program. Four achievement tests (two pre- and two post-) were given to all *Ss*, and a measure of creative thinking ability was administered prior to beginning the instruction. When all *Ss* were considered as a group, a significant negative correlation ($r = -.34$, $p < .05$) was obtained between creativity scores and scores on the first achievement posttest. The comparable correlation for the second achievement posttest was -.29.

The results reported by Gotkin and Massa (20) provide one piece of evidence for the tenability of the rationale presented above. Further investigations with different types of programed materials and a more representative sample of creative individuals is needed to determine if the negative correlation between creativity and achievement is a function of programed materials in general (i.e., the structure of programed materials), or of other factors..

One might also reason that sufficient reinforcement for making the appropriate response required by the structure of the program would have the effect of increasing the S's preference for convergent modes of responding. Consequently, one effect of experience with programed instructional materials may be a temporary reduction of the S's creative or divergent thinking abilities.

The second personality characteristic which appeared to the investigators to be of relevance for achievement with programed instructional materials is anxiety. A large body of research indicates that anxiety is negatively related to school achievement (42), especially achievement in areas involving verbal or reading skills (26). Sarason et al. (45) present empirical evidence for a theory of school anxiety in which the school anxious child is characterized as excessively dependent upon external support in the learning situation, and is easily disconcerted by evaluative and other adverse comments made by his teacher. They believe that the typical interpersonal relationship between the teacher and the elementary school student contains these and other elements which have the effect of making certain children anxious and insecure, and thus reduce the efficiency with which they learn in the classroom.

The dependency and emotionally reactive characteristics of the school anxious child also appear to restrict his ability to learn from different types of subject matter presentations. Research reported by Hill and Sarason (26), Gifford (18), and Grimes and Allinsmith (21), suggests that an optimal learning environment for the school-anxious child should be composed of elements which have been termed structure. Some of these elements are: (1) the teacher should cater to the child's need for explicitness in the requirements of the learning task; (2) information should be presented gradually and in an organized fashion with clear-cut rules for handling the information; (3) sufficient practice should be given the child at initial levels of the learning task so that adequate performance at higher levels is assured; and (4) feedback should be relatively continuous and positively reinforcing at all task levels to indicate to the child that he is progressing successfully in learning the task.

This analysis is supported from a basic theory of learning and drive level (9, 27). Essentially the theory states that there is an optimum level of drive for each learning task. The efficiency of learning a task is an inverted "U" function of drive level (anxiety) and the difficulty of the task. Individuals who score high on anxiety questionnaires are more reactive to drive inducing stimuli such as the difficulty level of the task. Thus, under certain conditions, they will perform less efficiently than individuals who score low on anxiety questionnaires.

From this analysis, it appears that programed instructional materials may offer an ideal structure for the optimal learning of the school-anxious individual. For one thing, the frequency of adverse cues (negative reinforcers), potentially involved in the social-emotional relationship between the anxious student and his teacher, are substantially reduced through the privacy of the programed learning situation. More important, however, is the potential which the typical programed learning sequence appears to hold for meeting the learning needs of the anxious student.

Objectives of the Research

The primary objectives of this research are to evaluate the relative importance of the contributions of selected characteristics of learners to success in learning from a representative program of the linear, constructed-response type. Based on the previous rationale the following research questions are raised:

1. To what extent do the creative thinking abilities of Ss contribute to their success in learning from programed instructional materials?

The rationale suggests that the creative thinking abilities of Ss will contribute negatively to their achievement from programed instructional materials. It is also possible that experience with programed instruction may habituate the S to more rigid and convergent modes of thinking due to the continuous practice and reinforcement in this type of thinking provided by the program. This would suggest that eventually some type of interference with divergent or creative modes of thinking would accrue, with the possible outcome of a temporary reduction in the S's creative verbal expression.

2. To what extent do the anxiety levels of Ss contribute to their success in learning from programed instructional materials?

At the elementary school level, test anxiety correlates negatively with performance on achievement tests involving both verbal and mathematical skills. The value of the correlation with verbal or reading achievement approaches -.50 at the upper elementary grade levels (26). The previous rationale suggests that with programed instructional materials, anxiety may make a positive contribution to achievement.

3. To what extent do the intelligence levels of Ss contribute to their success in learning from programed instructional materials?

The typical program attempts to provide for individual differences in ability through rate of response. It has been implied that this provision for individual rates of responding will result in achievement levels which will not differ greatly for Ss of different ability levels (31). Cattell and Sealy (7) estimate that approximately one-quarter of the variance of school achievement is attributable to general intelligence. It is of some importance to determine the contribution of intelligence to achievement from programed materials when the Ss are free to complete the program at their own individual rates in the normal classroom situation. It may be expected that intelligence would contribute positively to achievement with programed instructional materials.

In addition to the questions stated above, the design and analysis of the research made it possible to secure evidence regarding such questions as:

4. What is the extent of the contribution of the interaction of anxiety and the creative thinking abilities of Ss to their success in learning from programed instructional materials?

5. What is the extent of the contribution of the interaction of anxiety and the intelligence levels of Ss to their success in learning from programed instructional materials?

6. What is the extent of the contribution of the interaction of the intelligence levels and creative thinking abilities of Ss to their success in learning from programed instructional materials?

SECTION 2

METHOD

2.1: General Design of the Research

The major focus of the research was upon ascertaining the importance of sixth graders' verbal intelligence, verbal creativity and anxiety scores (and their interactions), as contributors to their success in learning from programed instructional materials. A sample of sixth graders was administered tests designed to measure these characteristics. These sixth graders then participated in a two-week classroom experience with programed instruction. The program selected for the research was entitled _Latitude and Longitude_. A measure of the level of learning of the concepts and factual material taught in the program was administered to each _S_ prior to and upon completion of the program. The dependent variable was the _Ss_' achievement at the end of the instructional condition as measured by a specially constructed criterion test. Multiple regression analysis was used to evaluate the relative importance of each of the learner characteristics and their interactions as contributors to sixth graders' success in learning from programed instructional materials.

In addition, this research investigated the possibility that exposure to programed instruction might have the effect of reducing the creative performance of _Ss_. Four of the classes which received programed instruction were compared with a control group of four classes which did not receive programed instruction. The dependent variables were the mean residual-gain scores for each class on the verbal creativity battery. The programed and nonprogramed groups were formed on the basis of random assignment of classes. Each group was given the verbal creativity battery shortly before and after the programed instructional treatment.

The preparations for the experimental phase of the research included the _pilot phase_. During this phase of the research a "dry run" was accomplished, using all of the materials and instruments which were later employed in the experimental phase of the research. The major objective of the pilot phase was to construct a criterion test to measure learning from the programed materials.

Part of the research effort was concerned with the validity and reliability of the anxiety score. This effort is reported in some detail in Section 2.4, since it presents some new data relevant to the use of questionnaire measures of anxiety in school situations.

In summary, the research involved four separate, but interrelated efforts. Each of these efforts will be reported separately in subsequent parts of this report. In the following section the characteristics of the sample which provided the source of data for all of the research efforts (with the exception of the pilot study) will be described.

2.2: Selection of Subjects

In choosing the sample of classes for the experimental phase of the research, it was necessary to select on the basis of several criteria. In general these were practical criteria, such as insuring that the bulk of the subjects had the reading level considered to be necessary for comprehending the material in the Latitude and Longitude program (25). To some extent, the use of the selection criteria resulted in a sample which may be characterized as nonrepresentative of sixth grade classes in general. However, for the most part the biases which may have been introduced by use of the selection criteria in this research do not seem to be overly serious with regard to generalization of results. In the following account, the procedures used in selecting the sample are described in detail. The reader will thus have an opportunity to judge for himself the possible biases which may have been introduced.

School officials in Hornell, Corning, and Painted Post, New York, agreed to participate in the research. The latter two cities support a combined school system. The 1960 census figures (24) estimate the population of Corning at 17,085, of Hornell 13,907, and of Painted Post 2,570. The three cities are rural-industrial centers in the West-central part of New York State. School officials in both systems provided information regarding grouping patterns in their schools, recent intelligence and/or reading test scores, and class lists indicating the number of pupils of each sex.

From the data provided by the school officials, an initial group of 19 sixth-grade classes was identified in the two participating school systems. The following criteria were then applied in further reducing the sample to meet the requirements of the research: (1) each class should contain a proportionately small number of Ss with reading problems (a reading problem is defined as a standardized grade equivalent reading score of less than 5.0); (2) the proportion of the sexes in each class and for the total sample should be equivalent; (3) each class should represent as far as is possible, a normal range of abilities; (4) the classes selected should be relatively homogeneous with respect to program of study and previous experience with programed instruction; and (5) teachers of the classes in the sample should not have begun systematic instruction in the subject matter of the program prior to the initiation of the research.

Four of the 19 classes comprising the preselection sample were rejected because of either low reading scores or a narrow range of IQ scores. Of the remaining 15 classes, it was determined that none had had previous experience with programed instructional materials. Discussions with school administrators indicated that the sixth-grade curricula in the various schools in both systems were quite similar (criterion number four). Criterion number five was also met by all classes.

The Lorge-Thorndike IQ Test, Level III, Verbal Form-A (30), was administered to the Ss in the sample of 15 classes by project staff members. The intelligence and sex distributions and reading scores of each of the classes were examined. Two classes were then eliminated because of extreme homogeneity of IQ scores. The remaining 13 classes were then randomly assigned to conditions, with four classes assigned to the control condition (no programed instruction), and nine to the experimental condition (programed instruction).

Table I presents the number of Ss in each experimental class with standardized grade-equivalent reading scores below 5.0. From initial tryouts of the Latitude and Longitude program (25) in teaching sixth graders, the writers concluded that a grade equivalent reading level of 5.0 was a minimum requirement for satisfactory performance on the program. It can be seen that this requirement has been met for all practical purposes in all but one of the classes. In class number 121, approximately 16 percent of the Ss were reading at a level below the acceptable minimum. This discrepancy, however, was not considered serious enough to reject the class for use in the research.

Table II shows the sex distributions of the pupils in the programed and control conditions, and the number of pupils lost in the final sample during the data collection period. These descriptive data are presented by class, as well as for the total programed and control groups. From these figures, it will be noted that 62 pupils were lost from the final sample during the data collection period. The losses constituted approximately 20 percent of the available total for each group. From the figures on sex, it is evident that the proportional representation of the sexes is lopsided in some of the classes (notably classes numbered 811, 911, 132, and 712). However, the proportional representation of the sexes in each condition (roughly 50 percent in each) was maintained, despite losses. Losses were almost entirely due to absences on test days.

Table III presents mean IQ scores with standard deviations and ranges for the final sample of 13 classes. It will be noted that the mean IQ score for the experimental group is 5.12 points higher than the mean for the control group. This difference, however,

Table I

Numbers of Pupils With Reading Limitations in the Programed Condition Classes

Hornell, New York

Class Number	Total N Reported	N Below 5.0
111	24	2
121	24	4
311	23	1
411	28	1
511	24	2

Corning-Painted Post, New York

Class Number	Total N Reported	N Below 5.0
721	22	1
811	23	0
821	23	0
911	21	0

Table II

Sex Distribution of Pupils in the Programed and Control Conditions and Pupils Lost in the Final Sample During the Data Collection Period

Programed Condition

	Complete Data*			Pupils Lost			Totals for Classes		
Class Number	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
111	11	8	19	2	3	5	13	11	24
121	10	11	21	3	0	3	13	11	24
311	10	8	18	3	0	3	13	8	21
411	14	11	25	3	1	4	17	12	29
511	10	10	20	3	1	4	13	11	24
721	10	9	19	2	1	3	12	10	22
811	4	11	15	4	3	7	8	14	22
821	6	8	14	4	5	9	10	13	23
911	5	9	14	2	4	6	7	13	20
Total	80	85	165	26	18	44	106	103	209

Control Condition

	Complete Data*			Pupils Lost			Totals for Classes		
Class Number	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
132	8	15	23	2	0	2	10	15	25
212	13	9	22	1	3	4	14	12	26
612	8	8	16	3	2	5	11	10	21
712	11	5	16	4	3	7	15	8	23
Total	40	37	77	10	8	18	50	45	95

Total Sample

	Complete Data			Pupils Lost			Total for Combined Classes		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
13 Classes	120	122	242	36	26	62	156	148	304

*Final sample upon which data are based.

is irrelevant to the major focus of the research which is concerned only with analyses for the experimental group.

Table III

IQ Means, Standard Deviations and Ranges of the Classes Selected to Participate in the Research

Programed Condition

Class Number	N	$\bar{X}$ IQ	SD	Range
111	24	110.55	17.0	78-140
121	24	105.75	12.9	79-133
311	21	108.90	13.6	89-138
411	29	115.10	12.6	91-140
511	24	108.30	11.5	90-140
721	22	110.60	14.6	88-147
811	22	102.45	14.6	91-140
821	23	109.60	12.2	84-134
911	20	110.25	11.2	91-129
Total "Programed"*	209	109.34	13.63	78-147
Total Less All Lost Ss**	165	110.72	13.39	78-147

Control Condition

Class Number	N	$\bar{X}$ IQ	SD	Range
132	25	103.00	12.4	77-124
212	26	108.05	12.5	94-143
612	21	106.00	16.3	81-131
712	23	106.05	14.5	84-138
Total "Control"*	95	105.73	13.75	77-143
Total Less All Lost Ss**	77	105.60	13.97	77-143

*Represents data collected from classes without lost subjects.
**Data collected only from the sample for which complete sets of scores on all instruments were available.

In summary, the final sample to be used in the research consisted of two groups: (1) an experimental group composed of a total of 165 Ss from nine classrooms in two separate school systems; and

(2) a control group composed of 77 Ss from four classrooms in the same two school systems. With classes combined, both groups had nearly equal numbers of the sexes. It was concluded that within the experimental group, only a small fraction of the Ss did not have the reading capability to enable them to achieve satisfactorily from the program used in the research.

2.3: The Pilot Phase of the Research:
Development of the Criterion Test

The major purpose of the pilot phase of the research was to construct a criterion test to be used for measuring the amount of achievement from the programed instructional sequence. Other objectives included: (1) trying out the Latitude and Longitude program (25) and refining a preliminary set of instructions for teacher use of the program; (2) administering the learner characteristics measures to ascertain the appropriateness of the administration procedures (e.g., timing, instructions, etc.); and (3) training project staff in the methods of administration of the learner characteristics measures, and in general familiarizing the staff with all procedures necessary for administration of the research during the experimental phase.

The purpose of this section is to describe the development of the criterion test. The accomplishment of the other three objectives was helpful in refining the procedures used in the experimental phase of the research.

The development of the criterion test was pursued in three stages. The first stage consisted of the preparation of 90 objective test items which formed the basis for the construction of two preliminary test forms. In the second stage, the program and learner characteristics measures were administered in the schools under conditions closely approximating those used in the experimental phase of the research. The final stage involved the administration of the two preliminary forms of the criterion test, and the construction of the final criterion test based on the results of this administration.

Stage One

Eighty-eight multiple choice items, with four choices for each question, were constructed to measure the objectives of the program. These items were either written by project staff or were taken from a test provided by Coronet Instructional Films Incorporated (8). Two additional questions were developed which required a brief written response (recording the latitude and longitude of a point indicated on a small map).

These items were constructed so that there would be equal numbers of items for evaluating each of the major objectives of the programed instructional sequence. Correct responses were evenly divided among the four choices of the multiple choice items. The 90 items constituted the original item pool. These items were then divided equally into two tests, Forms A and B. The major objectives of the program were evaluated by equal numbers of items in each form of the test.

Stage Two

Four sixth-grade classes in two public school systems (Savona, New York, and Campbell, New York) participated in the pilot phase of the research. The results to be reported are based on data obtained from a total of 84 Ss of both sexes, with each school system contributing 42 Ss to the total. None of the Ss had had previous instruction with programed materials.

The pilot phase of the research was initiated in the early part of October, 1965, and completed approximately two weeks later. With the exception of the preliminary forms of the criterion test, the learning materials and instruments used in the pilot study were the same as those used in the experimental phase of the research.[1] The Ss in both pilot schools received ten units of instruction using the program, Latitude and Longitude (25).

The preliminary forms of the criterion test were administered by project staff on the day following the last unit of the programed sequence. Equal numbers of both forms were distributed randomly to the Ss in each of the pilot classes. A 40 minute period was allowed for actual working time on the test forms. This proved to be ample time for each S to finish. Table IV summarizes the order of administration of the learner characteristics measures, the preliminary forms of the criterion test and the programed instructional sequence in the classes in both pilot schools.

On the day prior to the initiation of the first unit of the programed instructional sequence, the teachers explained to their classes the procedures involved in learning from programed materials and instructed them in the mechanics of using the sliding cover attached to the program. The teachers emphasized that the Ss would be tested upon completion of the program and that the results of the testing would constitute a normal part of classroom evaluation. The teachers were requested not to help the S with the

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[1] Details on the instruments used in the pilot phase of the research are given in Section 2.4.

Table IV

Schedule of Administration of the Learner Characteristics Measures,
The Preliminary Criterion Tests
and the Programed Instructional Sequence in the Pilot Schools

School Days	Campbell, N.Y.	Time (Min.)	Savona, N.Y.	Time (Min.)
Day 1	Verbal Creativity Battery	25	Lorge-Thorndike IQ Test	45
	Anxiety Test	25	Anxiety Test	25
Days 2-12	Ten Periods of Programed Instruction*			30 Per Period (Approx.)
Day 13	Anxiety Test	25	Anxiety Test	25
	Criterion Test (Forms A & B)	40	Criterion Test (Forms A & B)	40

*A school holiday interrupted the sequence of the instruction.

program or provide supplementary instruction in the subject matter of the program. An additional request was that the teacher continually observe that the *Ss* kept the confirming responses in the program concealed until they had recorded their own responses.

Each *S* was provided with a copy of the 1963 revision of the *Latitude and Longitude* program (25), and a 10-page mimeographed response booklet which the *S* was to use for recording his responses. The response sheets and programs were collected each day when instruction was completed. On each of ten school days, the *Ss* completed a scheduled unit contained in the program. Additional time beyond the half hour scheduled for the program was available to the *S* if necessary.

Stage Three

Item analysis procedures were used to determine the difficulty levels and discrimination indexes for the items in each form of the test. The discrimination index for each item was obtained as follows. Using total score on the form as an internal criterion, the proportion of Ss in the lower 27 percent of the distribution passing any given item was subtracted from the proportion of Ss in the upper 27 percent of the distribution passing the item. The difficulty level for an item was the percentage of the total number of Ss who answered the item correctly on a given form.

The final criterion test was then constructed by selecting the "best" 50 items from Forms A and B. The criteria employed for selection of items were: (1) each of the major topics of the programed instructional sequence should be evaluated by equal numbers of items in the final test; and (2) insofar as was possible, the items selected for the final test should have difficulty levels within the 40 to 60 percent range and discrimination indexes of 40 percent or greater.

A comparison of the distributions of item discrimination indexes and difficulty levels for the retained and rejected items is shown in Table V. The reader will note that generally items with very high or very low difficulty levels and items with low discrimination indexes were rejected from the original item pool. Three items with less than acceptable difficulty levels and discrimination indexes were retained in order to maintain proportional representation of each of the objectives of the programed instructional sequence. These items were revised before inclusion in the final form of the test in the hope that their discrimination power would be improved.

The 50 items selected for inclusion in the final form of the criterion test are listed in Table VI. The item number in the final form, and the discrimination index and difficulty level for each item are indicated. The mean discrimination index for the 50 items was 49.28 percent, with a range of zero to 83 percent. Sixty percent of the items had discrimination indexes of 50 percent or more; 24 percent of the items were in the range of 30 to 49 percent, and eight percent of the items had discrimination indexes of less than 30 percent. The mean difficulty level was 51.16 percent, with a range of difficulty levels of four to 71 percent. Fifty-six percent of the items were in the 40 to 60 percent difficulty range; 30 percent of the items were in the 61 to 71 percent range; and 14 percent of the items had difficulty levels of less than 40 percent.

Table V

Distributions of Difficulty Levels and Discrimination Indexes of Items Accepted and Rejected from the Original Ninety-Item Pool

Difficulty Level	Frequency (of items accepted for final test)	Frequency (of rejected items)
90-100	0	5
80-89	0	12
70-79	2	11
60-69	13	6
50-59	19	1
40-49	9	1
30=39	2	1
20-29	3	1
10-19	1	2
0-9	1	0
Total	50	40

Discrimination Index	Frequency (of items accepted for final test)	Frequency (of rejected items)
90-100	0	0
80-89	2	0
70-79	6	0
60-69	5	2
50-59	17	4
40-49	6	9
30-39	6	6
20-29	5	4
10-19	2	9
0-9	1	5
Negative	0	1
Total	50	40

The final criterion test consisted of 48 four-choice objective questions and two "fill-in-the-blank" questions. The three items with an asterisk in Table VI were changed before use in the final test. The "foils" and questions in these items were altered tc make them less ambiguous.

Table VI

Discrimination Indexes and Difficulty Levels for Each Item in the Final Criterion Test[1]

Item No.	Discrim. Index	Difficulty Level	Item No.	Discrim. Index	Difficulty Level
1	33	63	26	73	54
2	67	66	27	32	69
3*	0	4	28	38	28
4	43	54	29	47	50
5*	13	23	30	53	50
6	59	45	31	60	71
7	72	57	32	75	38
8	59	69	33	83	62
9	53	50	34	28	47
10	25	59	35	30	50
11	63	54	36	67	62
12	58	62	37	62	62
13	57	40	38	70	59
14	58	62	39	50	21
15	50	50	40	20	40
16	33	57	41	48	47
17	50	69	42	83	45
18	50	52	43	52	57
19	73	61	44	33	57
20	59	64	45	50	71
21	41	54	46	50	62
22	50	42	47	75	35
23	27	45	48	48	40
24*	17	16	49	25	57
25	57	52	50	45	54

*Items reconstructed before inclusion in the final criterion test.

The total score on the final criterion test was the number of correct answers out of a total of 50 expressed as a percentage.

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[1] The authors are indebted to Coronet Instructional films for 18 of the items used in the final form of the criterion test.

The instructions and timing for the preliminary forms of the criterion test were used for the administration of the criterion test in the experimental phase of the research. A copy of the instructions and the final form of the criterion test are presented in Appendix A.

2.4: Instruments, Materials and Procedures for the Experimental Phase of the Research

In this section, the instruments, materials and procedures used in the research will be described. The description for each instrument will include the procedures used in testing and scoring, the raw score results of the testing, and reliability estimates. Also included are the results of a validity study of a modified procedure for scoring the Test Anxiety Scale for Children (45). The data, except where indicated, are based on the final sample of 165 Ss who participated in the programed instructional condition.

General Testing Procedures and Schedule of Testing

All instruments utilized in the research were administered by project staff or by individuals with experience in psychological testing who were given further training in the special testing requirements. Table VII presents the schedule, order and testing times for the administration of all tests and the programed instructional unit. The reader will note that, with the exception of the IQ test, the tests were administered in the same order and on the same day to all classes participating in the experimental phase of the research. During all testing sessions, the individual classroom teachers were requested to leave the room until testing was completed.

The anxiety test was administered both before and after the programed learning sequence in order to obtain an estimate of the reliability of the anxiety scores, in this sample. The creativity battery was administered in the same sequence to obtain data about the possibility that exposure to programed instructional materials might have the effect of reducing the verbal creative performance of Ss. All posttest administrations (creativity, anxiety and the criterion test) used the same instruments and procedures as the pretest administration. Further procedural details concerning the administration of the instruments and the learning materials are given in the following sections.

Table VII

Schedule of Administration of the Learner Characteristics Measures, the Criterion Test and the Programed Instructional Sequence for the Experimental and Control Classes

Date (1965)	Programed Classes	Testing Time (Min.)	Control Classes	Testing Time (Min.)
Oct. 27-Nov. 1	Verbal IQ	45	Verbal IQ	45
Nov. 29	Anxiety & Creativity	25 + 25	Anxiety & Creativity	25 + 25
Nov. 30	Pretest Criterion	40	----	
Dec. 1-14	10 Consecutive Periods of Programed Instruction	30 (Approx.)	----	
Dec. 15	Posttest Criterion	40	----	
Dec. 16	Anxiety & Creativity	25 + 25	Anxiety & Creativity	25 + 25

The Learning Materials: Description, Effectiveness and Procedures for Administration in the Research

The program used in the research was, Latitude and Longitude, a two-week instructional unit designed for sixth-grade students and published by Coronet Instructional Films Incorporated. The authors of the program (25) state that students who had completed the program were able to:

*Understand basic terms which refer to the earth's movements, such as sphere, rotation, revolution, and axis.

*Know the meaning of degrees, minutes and seconds.

*Understand parallel lines, parallels, and latitude.

*Understand meridian, prime meridian and longitude.

*Find, read, write and identify locations from a globe or simple map.

The material in the program is presented in a linear format and requires the S to "construct" a response(s) for each individual frame. The program is organized into nine teaching units plus a final review and practice unit. Each unit consists of approximately forty frames, with each frame containing roughly from 10 to 50 words. The program has a soft cover with a built-in slider which is used to expose the correct response for each individual frame.

Field test data reported by the publishers (8), based on a sample of 335 Ss indicated that: (1) a high percentage of both students and teachers viewed the program favorably as indicated by questionnaire responses; (2) the program effectively accomplished the teaching objectives; and (3) the overall error rate for the program was less than the acceptable criterion of 10 percent.

Paulson (40) reported a study of the effectiveness of the Latitude and Longitude program for a sample of 131 fifth, sixth and seventh graders. The program was administered under conditions closely approximating those of this research. Paulson concluded that the program was an effective teaching device for sixth graders with average and above average IQ levels. In general, the error rates reported were below 10 percent on all units for sixth graders with average and above average ability levels. Mean time to complete each unit was 20 minutes for sixth graders of all ability levels. A mean gain of 25 percent on a posttest measuring the objectives of the program was recorded for all sixth graders (N = 48).

From Paulson's data, and from tryouts of the program in the pilot phase of the research, the investigators concluded: (1) that sixth graders, who were in either the normal range of abilities or who had standardized reading grade equivalent scores of 5.0 or greater, would be able to achieve satisfactorily from the program without supplementary instruction; and (2) that approximately one-half hour of school time would be sufficient for most sixth grade Ss of average and above average abilities to complete any of the ten units in the program.

The reader will recall from the discussion of the selection of subjects, that only a small fraction of the 165 Ss in the programed condition had standardized reading grade equivalent scores below 5.0. Approximately 86 percent of this sample had IQ's within or above the normal range. Thus with reasonable assurance, it was expected that nearly all Ss in the sample had the requisite abilities to achieve at a satisfactory level from the program selected for the research.

The materials used in the classroom consisted of new copies of the 1963 revision of the Latitude and Longitude program (25); a 10-page mimeographed response booklet which the S was to use for recording his responses; and a set of instructions for teacher use of the program which was designed to standardize the use of the program across all classrooms. Appendix B contains copies of a sample page from the student response booklet, the instructions for the teacher, and a sample unit of the program reproduced from the original.

Prior to the initiation of instruction, the investigators met with the participating teachers and explained the procedures for using the program in the classroom. Each teacher was provided with a new set of programs, a set of student response booklets and mimeographed instructions for using the program in the classroom. The teachers were requested to explain to their classes that they were participating in an experiment on programed instruction sponsored by Cornell University, but that they would be tested and graded upon completion of the program. That is, the Ss were to understand that the instruction from the program would be treated as part of the normal course of classroom instruction. It was emphasized to the teachers that they should not help the Ss with the program and that they should continually observe to see that the Ss were keeping the answers in the program concealed until they had recorded their responses in the response booklet.

On the day before beginning instruction, the teachers handed out the program and the response booklets. The teachers then read through the "foreword" of the program with their classes and instructed them in the use of the sliding cover. The foreword provided a general introduction to the procedures involved in learning from programed instructional materials. Additional instructions were given the Ss from the mimeographed instructions provided for each teacher.

On the following day, the Ss started work on the program during a one-half hour period which was set aside for this purpose. Additional time was available to the S if necessary. Teachers were requested to provide work in other subject areas for the Ss who finished the daily unit before the last S had finished. The Ss' response booklets and programs were collected by the teacher at the end of each instructional session. The response sheet for a completed set was removed from the booklet and sealed in an envelope. This procedure was begun on the same day for all classes and followed by all classes for ten consecutive periods of instruction.

The Anxiety Measure

The measure of anxiety used in the research was derived from the Ss' responses to the 30 items in the Test Anxiety Scale for Children (TASC) and the 11 items which comprise the Lie Scale for Children (LSC). Both scales are designed for use with children in grades one through six (45). The total of 41 items from both scales was presented in booklet form with the 11 LSC items interspersed at regular intervals among the TASC items. The subject was required to read each question and then respond by circling a "yes" or "no" on the right hand side of the page. The test was preceded by verbal instructions designed to stimulate honesty in answering the questions. Sufficient time was allowed each S (roughly 25 minutes) to complete the test at his own rate. A copy of the verbal instructions is included in Appendix C.[1]

The anxiety score used in the research will be referred to as the $\mathrm{TASC}_{\mathrm{adj.}}$ score, since it is based on a combination of the S's TASC score and his LSC score. The formula used in obtaining each S's $\mathrm{TASC}_{\mathrm{adj.}}$ score is:

$$\mathrm{TASC}_{\mathrm{adj.}} = \mathrm{LSC}_{\mathrm{score}}\left(\frac{\mathrm{SD}_{\mathrm{tasc}}}{\mathrm{SD}_{\mathrm{lsc}}}\right) + \mathrm{TASC}_{\mathrm{score}}$$

which in this case was equal to: $\mathrm{LSC}_{\mathrm{score}}\left(\frac{6.181}{1.898}\right) + \mathrm{TASC}_{\mathrm{score}}$

where $\mathrm{SD}_{\mathrm{tasc}}$ is the standard deviation of the obtained TASC scores of the 165 Ss in the programed condition, and $\mathrm{SD}_{\mathrm{lsc}}$ is the standard deviation of the obtained LSC scores for that sample. The formula, in effect, adjusts the LSC scores of the *Ss* to the same variance as their TASC scores. The TASC$_{adj.}$ score for each *S* thus represents the arithmetic sum of his TASC score and his weighted LSC score, and is regarded as an estimate of his "true" anxiety score.

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[1] The verbal instructions were adapted for the research from the standard instructions developed for use with the TASC by Sarason et al. (45). The requirement that S read the items to himself in a booklet and the method of scoring for anxiety are modifications of the standard procedures for administering and scoring the TASC and LSC. The items themselves were not modified.

As used in this research, the TASC is considered to be a measure of *school* anxiety rather than *test anxiety per se*. An examination of the scale (cf. 45) will indicate to the reader that many of the items refer to school and school-related situations other than the academic test situation. Dunn (1[illegible]) has presented factor-analytic evidence suggesting that the TASC consists of at least four independent but school-related dimensions of anxiety.

The LSC contains items termed "universal" anxiety experiences (e.g.,"When you were younger, were you ever scared of anything?"). "No" answers to items in the LSC are considered to reflect the tendency to be defensive about the admission of anxiety (45); a tendency which reduces the validity of the *S*'s anxiety score as measured by the TASC.

Recent research has indicated that the extent of defensiveness (as measured by the LSC) exhibited by upper elementary grade children substantially affects the predictive validity of TASC scores for intellectual and academic performance criteria. Thus Hill and Sarason (26) have shown that the negative correlations between test anxiety scores and measures of test performance may be approximately doubled by "partialling" out lie scores. The increase in validity coefficients obtained through this approach, in addition to other evidence suggesting similarities between anxious and defensive children (26, 42), suggested that a better estimate of the *S*'s "true" anxiety score would be a combination of his TASC and LSC scores.

In the remainder of this section, evidence for the validity of the TASC$_{adj.}$ score as a measure of anxiety will be presented in addition to data on the distribution and reliabilities of LSC, TASC, and TASC$_{adj.}$ scores. In one instance, TASC, LSC and TASC$_{adj.}$ scores were correlated with scores on the tests of intellectual and academic performance used in the research. It was reasoned that support for the greater validity of the TASC$_{adj.}$ scores would be obtained in the event that this score had higher validity coefficients with the test performance criteria than did the TASC alone. In the second instance, teachers' rankings of children's anxiety were correlated separately with children's TASC, LSC and TASC$_{adj.}$ scores. It was expected that the more valid anxiety score would be in evidence in such a comparison, given that valid ratings of children's anxiety could be obtained from teachers untrained in clinical judgments.

Means, standard deviations, and ranges of TASC, LSC and $\text{TASC}_{\text{adj.}}$ scores from both pretest and posttest administrations are shown in Table VIII. Note that TASC scores decreased on the average by 2.78 score points between the pretest and posttest administrations, while LSC scores increased an average of 1.20 (adjusted) score points during the same period. The mean decrease in posttest TASC scores is somewhat offset through the use of the $\text{TASC}_{\text{adj.}}$ score, which showed a mean decrease of 1.85 score points on the average over the two-week period of the research. These data are consistent with those obtained by other investigators on repeated administrations of the TASC and LSC (45).

Table VIII

Means, Standard Deviations and Ranges of Pretest and Posttest LSC, TASC and $\text{TASC}_{\text{adj.}}$ Scores

(N = 165)

	Pre-LSC	Pre-TASC	Pre-$\text{TASC}_{\text{adj.}}$	Post-LSC	Post-TASC	Post-$\text{TASC}_{\text{adj.}}$
$\bar{X}$	2.12	12.44	19.33	2.49 (+1.20)*	9.66 (-2.78)	17.48 (-1.85)
SD	1.90	6.18	7.25	2.04	6.41	7.20
Ranges	0-10	0-26	2.0-42.5	0-10	0-27	4.0-37.68
Max. Poss. Score	11	30	65.75	11	30	65.75

*Numbers in parentheses indicate mean decrease or increase from pretest to posttest.

Table IX shows the intercorrelations of pretest and posttest LSC, TASC, and $\text{TASC}_{\text{adj.}}$ scores. Figures indicated by an asterisk give the stability coefficients (roughly two weeks between test administrations) for the three test scores. The stability coefficient for $\text{TASC}_{\text{adj.}}$ scores is lower than that for TASC scores (.66

versus .76). The lower figure for the $\text{TASC}_{\text{adj.}}$ is in part accounted for by the changes in scores on the LSC and TASC which occurred on retest, reported in Table VIII. The changes in LSC and TASC scores on retest have been attributed to changes in children's defensiveness accompanying repeated administrations of the LSC and TASC over short periods of time (45). For the present study, it is to be noted that changes in both TASC and LSC scores appear to contribute to unreliability of the $\text{TASC}_{\text{adj.}}$ scores in this sample over short periods of time.

Table IX

Intercorrelations of Pretest and Posttest LSC, TASC and $\text{TASC}_{\text{adj.}}$ Scores

(N = 165)

	Pre-TASC	Pre-$\text{TASC}_{\text{adj.}}$	Post-LSC	Post-TASC	Post-$\text{TASC}_{\text{adj.}}$
Pre-LSC	-.31	.59	.66*	-.21	.40
Pre-TASC		.59	-.34	.76*	.37
Pre-$\text{TASC}_{\text{adj.}}$			.27	.47	.66*
Post-LSC				-.37	.56
Post-TASC					.56

*Two-week test-retest correlations.

Table X presents the correlations of TASC, LSC and $\text{TASC}_{\text{adj.}}$ scores with pretest criterion, posttest criterion and verbal IQ scores for the 165 Ss who participated in the experimental phase of the research. TASC, LSC and $\text{TASC}_{\text{adj.}}$ scores correlate negatively and significantly with each of the test performance criteria. These results are consistent with those obtained by other investigators using the same personality measures and similar test performance criteria (26). Note that the use of the $\text{TASC}_{\text{adj.}}$ score results in a substantial increase in the correlation with the three test performance criteria over that yielded from the LSC or TASC alone.

Differences between the correlations of TASC and $\text{TASC}_{\text{adj.}}$ scores with the criterion scores and the IQ score shown in

Table X

Correlations of the TASC, LSC and $\text{TASC}_{adj.}$ Scores With Pretest Criterion, Posttest Criterion and IQ Scores

(N = 165)

Independent Variables	Pre-CRIT	Post-CRIT	IQ (Verbal)
LSC+	-.26	-.28	-.26*
TASC	-.35	-.34	-.28
$\text{TASC}_{adj.}$	-.52	-.53	-.46

+Independent variables are pretest scores.

*A correlation of .21 is significant at the .005 level (one-tail).

Table X were evaluated using a t test for nonindepdent correlations (14). The r between $\text{TASC}_{adj.}$ scores and pretest criterion scores is significantly higher ($t = 2.81$, $p < .005$) than the r between TASC scores and pretest criterion scores. The r between $\text{TASC}_{adj.}$ scores and posttest criterion scores is significantly higher ($t = 3.16$, $p < .005$) than the r between TASC scores and posttest criterion scores. The r between $\text{TASC}_{adj.}$ scores and IQ scores is significantly higher ($t = 2.85$, $p < .005$) than the r between TASC scores and IQ scores.[1] Thus the use of the $\text{TASC}_{adj.}$ score results in significant increase in the correlation with IQ and criterion test scores over that yielded by the TASC alone.

All teachers participating in the experimental phase of the project were requested to rank each of the individuals in their classes with respect to a definition of school anxiety developed by one of the investigators (39). Essentially the definition described a number of common classroom situations (tests, recitation, disciplinary actions, etc.) with corresponding "anxious" behaviors which were culled from the literature and experience. Each teacher was requested to keep the definition on his desk for a one-week period. During that time he was asked to observe the children in his class with respect to the definition and to make some preliminary rankings of each child in his class. At the end of the week each teacher was provided with a set of instructions and materials for completing the final ranking. The child with the highest judged level of anxiety was given a rank of one, the second in order was given a rank of two, and so on. A copy of the anxiety definition with the ranking instructions given to the teacher is presented in Appendix D.

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[1] All tests are one-tailed with 162 degrees of freedom.

The rank each child received was correlated with his LSC, TASC and $\text{TASC}_{\text{adj.}}$ scores. These data are presented in Table XI for eight of the total of 13 teachers who completed the rankings.[1]

As shown in Table XI, the averaged correlations of the LSC, TASC and $\text{TASC}_{\text{adj.}}$ with teacher's anxiety rankings (TR) are in the expected direction. However, only the averaged correlations between the TR and TASC and $\text{TASC}_{\text{adj.}}$ are significant. Thus, if only averages are considered, the data do not support the expectation that the $\text{TASC}_{\text{adj.}}$ score would be a more valid estimate of anxiety than the TASC score (provided of course that teacher's anxiety rankings can be considered a valid criterion).

The correlations of LSC, TASC and $\text{TASC}_{\text{adj.}}$ scores with teacher's anxiety rankings, when examined for each individual teacher, do not present a pattern which is entirely consistent with expectations. LSC, TASC and $\text{TASC}_{\text{adj.}}$ scores correlate at no better than chance magnitudes with the rankings of teachers 1, 5, 7 and 8 (with the exception of the significant correlation of .47 between LSC scores and the anxiety rankings of teacher 8). On the other hand, the correlations of these scores with the anxiety rankings of three of the four remaining teachers (teachers 2, 4 and 6) tend to support expectations regarding the greater validity of the $\text{TASC}_{\text{adj.}}$ score as a measure of anxiety. Little confidence can be placed in the higher correlations of $\text{TASC}_{\text{adj.}}$ scores with TR scores in these three instances, since none of the differences between the r's of the TASC and $\text{TASC}_{\text{adj.}}$ scores with TR scores are significant.

In summarizing the evidence obtained for the validity of the $\text{TASC}_{\text{adj.}}$ as a measure of anxiety, it may be concluded that: (1) the use of the $\text{TASC}_{\text{adj.}}$ score results in a substantial and significant increase over the TASC alone in the prediction of performance on a measure of verbal IQ, and on an achievement test which measures the

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[1] One of the nine teachers in the programed condition completed the ranking incorrectly. The four control teachers' rankings were not included due to practical limitations of the project.

Table XI

Correlations Between Teacher's Anxiety Rankings and Children's LSC, TASC and $TASC_{adj.}$ Scores[1]

Teacher	N	LSC	TASC	$TASC_{adj.}$
1	(21)	.00	-.09	-.07
2	(18)	-.28	-.37	-.45*
3	(25)	-.07	-.43**	-.40**
4	(20)	-.17	-.56***	-.69***
5	(19)	.07	-.04	.03
6	(15)	-.53**	-.50*	-.64***
7	(14)	.36	-.30	-.05
8	(14)	.47*	-.23	.20
Average[a]				
r		-.13	-.33***	-.31***

[a] Fisher's z transformation was used to compute the average *r*'s (McNemar, 1962).

*--- $P < .05$ (one tail)

**--- $P < .025$(one-tail)

***---$P < .005$ (one-tail)

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[1] A low score or rank given a child by the teacher equals a high level of observed anxiety in a particular child. Scoring for the TASC, LSC and $TASC_{adj.}$ are in reverse of this. Thus, a negative correlation is indicative of agreement between teacher's anxiety rankings and children's anxiety scores.

concepts of latitude and longitude; and (2) there is a slight but statistically unreliable tendency for the $\text{TASC}_{\text{adj.}}$ score to correlate higher with teachers' rankings of children's anxiety than the TASC alone. Since interest in the $\text{TASC}_{\text{adj.}}$ score is presently limited to its application in this research, these data are in the opinion of the authors, sufficient justification for selecting the $\text{TASC}_{\text{adj.}}$ score as a more valid measure of anxiety than the TASC score.

The Creativity Measure

The measures of verbal creativity used in this research were devised through factor analysis of a number of available and originally designed tests by Dacey and Ripple (11) in connection with a related research project.[1] The battery contains four separate subtests of verbal creativity titled Imagination, Asking Questions, Guessing Causes and Guessing Consequences. A brief description of each subtest together with examples of scoring is presented below:

Imagination:

For this subtest, subjects are instructed to write as imaginative and divergent a story as they can about a picture of a cat and a box. Each story is scored for imagination from zero to two on the basis of 11 criteria typically found in creative stories. Total time, without instructions for this subtest is five minutes.

A score of zero indicates the absence of one of the 11 characteristics; a score of one indicates that the characteristic is present; and a score of two is given when the characteristic is unusually apparent in the S's writing. The 11 characteristics used in scoring are: (1) picturesque speech; (2) vividness; (3) original setting or plot; (4) individuality of style; (5) becomingness; (6) imagination (fantasy); (7) finding the essence (a dimension of conciseness or succinctness); (8) perceptive sensitivity (the use of metaphors and analogies); (9) flexibility or versatility (fresh, vigorous language; absence of cliches); (10) coherent unity of story; and (11) expressive communication element (expression of mood or feeling). Total score possible is 22.

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[1] This brief report is adapted from a more complete report of the Learning Structures Project which will become available from Professors Richard Ripple, Jason Millman, and Marvin Glock of the School of Education at Cornell University, in July, 1967.

Asking Questions:

This subtest is scored for flexibility. Subjects are asked to respond with as many relevant questions to a picture of an elf looking into a pool as they can in five minutes. An S's question must not be able to be answered merely through inspection of the picture. One point is scored for a relevant response made in any of 20 categories (such as location and setting of the picture; physical action unrelated to the surface; meaning and general interpretation of the picture; occupation of the person in the picture, etc.). Thus the maximum obtainable score on this subtest is 20 (one reference per category).

Guessing Causes:

This subtest is scored for originality. Subjects suggest as many causes of the elf's behavior as they can in five minutes. Responses are scored from zero to two, depending upon their predetermined statistical rarity. The statistical rarity of a response is based upon responses obtained from a large sample. Responses typically made by more than five percent of the standardization sample receive a score of zero. Responses typically made by from two to five percent of the standardization group receive a score of one. Any other relevant response receives a score of two.

Guessing Consequences:

This subtest is scored for fluency. Subjects are asked to respond with as many results of the action in the picture as they can in five minutes. One point is scored for each relevant consequence given by the S.

The criteria used in scoring the imagination test were originally derived from a manual of 22 criteria developed by Torrance, Peterson and Davis (55). The eleven criteria used for scoring the test of imagination in this research were those of the original 22 which had the highest loadings on the first general factor in a factor analytic study of the imagination subtest (11). The other three subtests of the creativity battery were originally derived from Torrance's Minnesota Tests of Creativity, Verbal Form A (52).

The creativity battery was administered in booklet form under the title, Student Abilities Survey. Identical tests were given for both pretest and posttest administrations. Approximately 25 minutes were required during each administration for the S to complete the test, including time for distribution and instructions. A complete copy of the test is given in Appendix E.

The four subtests were scored by a single member of the project staff. An overall index of verbal creativity was obtained by additively combining the raw scores from the four subtests. Table XII presents intrascorer stability coefficients for the four creativity subtests and total creativity score. These coefficients were calculated from a sample of 38 tests selected randomly for rescoring from the total number of tests available from both pretest and posttest administrations. The time interval between initial scoring and rescoring varied from a few days to three months. The reader will observe that the stability coefficients for flexibility, originality, fluency and total creativity are encouragingly high, whereas the coefficient for imagination demonstrates at least acceptable scoring stability.

Table XII

Intrascorer Stability Coefficients for Four Creativity Subtests and Total of Creativity Subtests

(N = 38)

	Initial Scoring		Second Scoring		Stability Coefficient
Test	$\bar{X}_x$	SD_x	$\bar{X}_y$	SD_y	r_{xy}
1. Imagination	5.7	1.9	5.8	1.6	.678
2. Flexibility	4.7	2.7	4.9	2.9	.948
3. Originality	1.5	2.3	1.0	1.7	.925
4. Fluency	4.4	2.9	4.7	2.9	.973
5. Total (sum of 1, 2, 3, 4)	16.3	7.1	16.4	6.5	.965

Table XIII shows the means, standard deviations and ranges of the raw scores obtained from the pretest and posttest administrations of the creativity battery to the 165 Ss in the experimental group.

The data are presented for each of the creativity subtests and for the combined creativity score. As can be observed in Table XIII, the pretest and posttest means for imagination, flexibility and fluency are roughly comparable in value. The comparable mean scores for originality, however, are considerably lower than those obtained for the other three subtests. The standard deviations of the scores on all subtests are nearly equivalent for the pretest administration. By comparing these measures for both administrations of the creativity battery, it will be noted that there are only slight changes in the means and standard deviations of the posttest scores for imagination, flexibility, originality and total creativity. For the remaining subtest, fluency, the figures show that the standard deviation for posttest fluency scores increased by roughly one-third, over the figure given for pretest fluency scores.

Table XIII

Means, Standard Deviations and Ranges
of the Creativity Subtest Scores
and Total Creativity Scores (Pre- and Post- Tests)
for the Experimental Subjects
(N = 165)

	Pretest			Posttest		
	$\bar{X}$	Range	SD	$\bar{X}$	Range	SD
Imagination	6.29	0-14	2.51	6.33	0-14	2.47
Flexibility	4.65	0-11	2.36	5.68	0-12	2.78
Originality	1.72	0-11	2.51	1.67	0-15	2.28
Fluency	5.26	0-16	2.95	5.53	0-23	4.05
Total Creativity	17.92	4-51	7.30	19.22	4-45	7.62

Table XIV shows the test-retest stability coefficients for the four creativity subtest scores and the combined creativity scores. The correlation coefficients are based on the scores obtained from the pretest and posttest administrations of the creativity battery to the 165 Ss in the experimental group. The obtained scores for the imagination subtest demonstrate the lowest degree of stability (r = .39) over the two week test-retest period, followed by flexibility scores (r = .55), originality scores (r = .59), fluency scores (r = .65) and total creativity scores (r = .71). These data, in addition to the data reported in Table XIII suggest some degree of fluctuation in the individual measurements of the four separate factors of verbal creativity from the pretest to the posttest administration.

Table XIV

Two-Week Test-Retest Stability Coefficients
of the Creativity Subtests
and Total Creativity Score
(N = 165)

Subtest	r
Imagination	.39
Flexibility	.55
Originality	.59
Fluency	.65
Total Creativity	.71

Table XV presents the intercorrelations of the creativity subtest scores and total creativity scores for the 165 Ss in the experimental group. The correlations are presented for both pretest and posttest administrations of the creativity battery. It will be observed that the intercorrelations of the subtest scores are low for both administrations of the tests. In general, the intercorrelations of posttest scores on the creativity battery are somewhat lower than the corresponding intercorrelations obtained from the pretest scores. These data support the logical distinctions made among the four subtests, and also the treatment of each subtest score as a relatively distinct element of verbal creativity.

Table XV

Intercorrelations of Creativity Subtest Scores and Total Creativity Score

(N = 165)

Pretest Creativity	Flex.	Orig.	Flu.	Total
Imag.	.30	.39	.36	.49
Flex.		.28	.25	.36
Orig.			.40	.51
Flu.				.62

Posttest Creativity	Flex.	Orig.	Flu.	Total
Imag.	.18	.20	.19	.55
Flex.		.25	.26	.63
Orig.			.28	.60
Flu.				.77

In summary, the creativity battery used in the research was constructed on another sample to measure four conceptually and empirically distinct elements of verbal creativity. In this research, the objective method of scoring the Ss free responses in the four subtests was demonstrated to be highly reliable. When applied to the particular sample of Ss in this research, the measurement procedures resulted in four subtest scores which had the following major characteristics: (1) individual scores appeared to fluctuate over a two-week period, especially the imgination subtest; and (2) the intercorrelations of the subtest scores indicate that the expected independence of the subtest scores was realized in this sample.

The Final Criterion Test

The final criterion test was administered in booklet form under the title, Latitude and Longitude. Identical tests were given for both pretest and posttest administrations. A total of 40 minutes was allowed each S to complete the test, including time for distribution and instructions. Each S had sufficient time to attempt every item on the test.

The results of the posttest administration were analyzed using the same item analysis procedures as for the pilot phase administration. Each S's total score on the test was expressed as the percentage of answers scored correct out of a total of 50.

The discrimination index and difficulty level for each item, based on total score on the posttest administration, are presented in Appendix E. These data are summarized in Table XVI. The mean difficulty level for the 50 items was 57.12 percent, with a range of 22 percent to 79 percent. The mean discrimination index was 50.04 percent, with a range of -.09 percent to 83 percent. These data indicate that the test was somewhat "easier" for the experimental phase sample than for the pilot phase sample. The mean difficulty level for the pilot sample was 51.16 percent, with a range of four to 71 percent. The overall discrimination index for both samples, however, remained comparable. The means and ranges of the discrimination indexes for the pilot and experimental phase administration are respectively 49.28 percent and 50.04 percent, with ranges of 0 to 83 percent and -.09 to 83 percent.

Measures of central tendency and dispersion for the pretest and posttest administrations of the final criterion test are presented in Table XVII. These figures are based on the percent of correct answers for the Ss who completed the test during the pretest and posttest administrations in the experimental phase of the research. The means and medians in each of the distributions nearly coincide. However, the mode for the pretest distribution (32 percent) is roughly 6 to 7 percentage points less than the mean and median, indicating that the pretest distribution is slightly skewed in the positive direction. The distribution of percentage scores of the posttest administration is likewise skewed in the positive direction. The mode (42 percent) is approximately 15 percentage points less than the mean and median.

Table XVII shows that the standard deviation of the percentage scores for the pretest criterion is 13.9, with a range of 16 to 80 percent. Comparable figures for the posttest are 20.36 with a range of scores of 8 to 96 percent, indicating that the experience with the program increased the range and dispersion of the criterion scores. The overall gain on the posttest was in excess of 17 percent

Table XVI

Summary of Difficulty Levels and Discrimination Indexes for the Posttest Administration of the Final Criterion Test

(N = 206)[1]

Level of Difficulty

Ranges of Difficulty Levels	No. of Items
80% to 100%	0
60% to 79%	20
40% to 59%	27
20% to 39%	3
0% to 19%	0
Total Range of Difficulty Levels..................	22% to 79%
Mean Difficulty Level............................	57.12%

Discrimination Indexes

Ranges of Discrimination Indexes	% of the Test
50% or over	48
30% to 49%	42
29% or less	10
Total Range of Discrimination Indexes............	-.09% to 83%
Mean Discrimination Index........................	50.04%

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[1] These data are based on all subjects in the sample who participated in the experimental phase of the research. The N was eventually reduced to 165 since some of the Ss did not have scores on all tests used in the analyses for the experimental phase of the research. The means and standard deviations of the pre- and posttest criterion scores differed only by small fractions when comparing the total sample of 206 Ss with the 165 Ss for whom complete data were obtained.

Table XVII

Measures of Central Tendency and Dispersion for the Pretest and Posttest Administrations of the Final Criterion Test

(N = 206)

	N	$\bar{X}$	SD	Med.	Mode	Range
Pretest	201	39.81%	13.9%	38.4%	32%	16% to 80%
Posttest	206	57.76%	20.36%	57.8%	42%	8% to 96%

(mean percentage correct on the posttest minus the mean percentage correct on the pretest). The difference was evaluated through a _t-test_ for correlated means, yielding a _t_ of 16.58 which is highly significant.

The reliability of the criterion test was estimated by both the test-retest method and the split-halves method. The _Kuder-Richardson Formula 20_ (10), which yields a reliability figure based on the mean of the correlations resulting from all possible split-halves of items in the test, was applied to the raw scores of a sample of 101 post criterion tests drawn randomly from the total of 206 tests.[1] A test-retest stability coefficient was obtained by correlating the pretest and posttest scores (expressed as percentages of items correct out of the total) of the 165 _S_s constituting the sample for the experimental phase of the research. The Kuder-Richardson reliability coefficient was .91; the test-retest stability coefficient was .75.[2]

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[1] A computer program written by Lawrence Wightman, Cornell Computing Center, was used to calculate the K-R reliability figure.

[2] The lower reliability coefficient yielded by the test-retest method undoubtedly reflects the learning experience with the program which intervened between the two administrations of the criterion measure.

The Intelligence Test

A measure of verbal IQ was obtained from the Ss participating in the experimental phase of the research through the administration of the Lorge-Thorndike IQ Test, Level-III, Verbal Form A (30).

The raw scores were subsequently converted to IQ scores. The IQ scores for the 165 Ss (reported previously in Table III) had a mean of 110.72 and a standard deviation of 13.39.

A reliability coefficient for alternate forms of the test is reported as .896; split-half reliabilities for the various subtests range from .802 to .849 (30).

SECTION 3

RESULTS

3.1: The Relative Importance of Anxiety, Verbal Creativity and Verbal Intelligence as Contributors to the Prediction of Achievement with Programed Instructional Materials

In previous sections discussion has centered on three major topics: (1) the rationale and objectives of the research;:(2) the procedures used in selecting the sample and administering the research in the schools; and (3) a presentation of the evidence for the reliability (and where possible, validity) of the instruments used in the research. The research was designed with the following aims:

(1) Evaluating the relative importance of verbal intelligence, verbal creativity and anxiety as contributors to the prediction of achievement from the programed instructional unit used in the research.

(2) Evaluating the possible effects of ten consecutive half-hour sessions of learning from programed instructional materials on the verbal creativity test scores of learners.

The results of these undertakings will be presented separately in this section.

Selection of the Statistic for Evaluating the Major Objectives of the Research

The objectives of the research were stated in the introductory section. That is, the major interest of the research focused on ascertaining the relative importance of the independent variables, verbal creativity (four subtest scores), verbal intelligence and school anxiety, as contributors to the prediction of achievement from programed instructional materials. Sex and previous knowledge of the learning material in the program (pretest criterion score) are included as "control" variables. In addition to these eight variables, the possible double interactions of verbal creativity, verbal intelligence and anxiety were included as secondary objectives out of empirical interest. The total number of independent variables (including control variables) is thus 17.

The answer to the question concerning the relative importance of each of the independent variables as contributors to the prediction of achievement from programed instructional materials may be arrived at through a multiple regression analysis. A more detailed and formal account together with an example illustrates the procedure used. Beginning with a certain number of predictor variables X_2, X_3 .... X_j, and a criterion X_1 expressed in raw score form, the procedure is to assume a linear model with the general form:

$$X_1 = b_2X_2 + b_3X_3 + b_4X_4 + \ldots\ldots\ldots\ldots b_nX_n + c$$

where X_1 is the criterion predicted on the basis of the n predictors weighted for the numbers b_2 ..... b_n, plus an additive constant c.

The regression coefficients b_2 ...... b_j give the weights to be assigned to the scores of each of the independent variables when X_1 is estimated from all these in combination. The individual regression coefficients may be interpreted as the weight which each variable exerts in determining X_1 when the influence of the other variables in the regression equation is held constant. The beta coefficients, or standard partial regression coefficients, (B) may be interpreted as indicators of the relative importance of each of the independent variables as contributors to the prediction of the dependent variable (3, 12, 34).

In order to determine whether each of the independent variables has anything unique to contribute to the prediction of the dependent variable (taking into account its relation to the other independent variables in the regression equation), a significance test (34, p. 142) is applied to each of the regression coefficients. In the present notation the test is:

$$\underline{t} = \frac{b_{X_j}}{SE^{b}{}_{X_j}}$$

Where H_o specifies that the population regression weight (B) is zero. The obtained t is evaluated by reference to the t distribution, with N - n - 1 degrees of freedom, where n equals the number of predictor variables in the regression equation.

The total proportion of the variance of the dependent variable predicted by the model is expressed by the coefficient of multiple determination, R^2. The predicted variance may be further subdivided into the variance components accounted for by each of the predictors when combined in the multiple regression equation. This may be accomplished by means of formulas given by Guilford (23, pp. 398-400).

The inclusion of interaction terms as independent variables in the multiple regression equation requires some modification of the model shown above. Simple interaction effects have been assessed in previous studies by calculating interaction scores for each S from the cross products of the Ss' scores on the independent linear variables selected for a regression equation (Cf. 5). These scores are then used as additional independent variables in the multiple regression equation. The beta weights thus obtained are then used as the basis for conclusions concerning the unique contributions or effects of the linear variables and their interactions on the dependent variable.

It can be shown that interaction terms used in this way in a multiple regression equation, may affect the values of the weights received by the linear variables. If the interaction term is nonzero (i.e., it receives a nonzero weight), it can be shown that the regression weights received by the linear variables are in part a function of their means. In order to obtain the "true" weights for the linear variables (where the cross products of the linear variables are included as interaction terms in the multiple regression equation), it is necessary to standardize the linear variables to means of zero. A proof for this assertion is given in Appendix G.

Thus the regression model used in the research may be more accurately expressed by the following restricted example:

$$z_1 = B_2 z_2 + B_3 z_3 + B_4 (z_2 \cdot z_3) + A$$

in which the linear variables are expressed in z-score form, and the interaction term is shown as the cross product of the independent linear variables.

Procedures for Analysis

The individual contributions of the predictor variables to the prediction of the dependent variable were analyzed using a step-wise multiple regression procedure. The computations were performed using the Control Data 1604 Computer and a "canned" program for the step-wise regressions, available at the University's Computing Center.[1]

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[1] The title of the program is, Regression, Factor Analysis and Correlation (Cornell Computing Center, 1965). Further details on the procedures used in obtaining the step-wise regressions are given in Appendix H.

Essentially, the step-wise regression program selects variables among the available set of predictors, one at a time, in the order in which they contribute to the prediction of the dependent variable. That is, the first predictor variable selected is that one of all the predictors which accounts for the most variation in the dependent variable. After the first variable has been selected for a regression equation, the program then ascertains which of the other predictors, in combination with the first predictor, accounts for the most variation in the dependent variable. Sufficient of the independent variables are added to the regression equation until, if one more were added, the squared multiple correlation (R^2) would be increased by less than .001. In that event, such a variable would not be added and the process ceases. Separate regression lines are written for each step, from the first step containing a single predictor, to the step which contains the most or all predictors.

The maximum number of regression equations obtainable with this procedure is equal to the number of independent variables. This additional refinement was used to select the most valid regression equation from among the obtained regression equations. Since in the present case, major interest is in ascertaining which variables are important as contributors to the prediction of the criterion, the emphasis in selection should be on the regression coefficients of the independent variables. This involved selecting the step (i.e., the regression equation) in the step-wise regression results, at which variables with nonsignificant beta coefficients were added to the regression equation. The result is a regression equation with a particular combination of predictors, each of which contributes significantly and uniquely to the prediction of the criterion.

The 165 Ss who received the two-week instructional experience with the Latitude and Longitude program constituted the source of data for the step-wise regression analyses. The Ss scores on all independent linear variables and the dependent variable were converted to z scores. Nine interaction scores were calculated for each S from all the possible double interactions of the Ss' z scores on the anxiety scale, the creativity subtests and the IQ test. These scores were used as the input data for the regression analyses. There were no missing observations.[1]

Table XVIII shows the variable identification numbers and the means and standard deviations of all independent variables and the dependent variable used in the regression analyses. It will be observed that scores for the independent linear variables (variables two through nine) and the dependent variable (variable one) have means of zero and standard deviations of one. The means for the Ss' scores on the interaction terms are all less than one, with standard deviations of one or slightly greater than one.

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[1] The procedures for the step-wise regressions are described in further detail in Appendix H.

Correlational Results

Table XIX shows the intercorrelations of the standardized scores on the independent linear variables, scores on the interaction terms, and standardized scores on the dependent variable.

The zero order correlations of the 17 predictor variables with the criterion variable have been extracted from Table XIX and are shown in rank order of magnitude in Table XX. From these it will be seen that the best single linear predictor of the dependent variable is pretest criterion (r = .75), followed by verbal IQ (r = .74), anxiety (r = -.53), imagination (r = .43), fluency (r = .38), originality (r = .21), flexibility (r = .21), and sex (r = -.11). With the exception of sex, which is nonsignificant ($p > .05$), the correlations of these variables with the dependent variable all reach acceptable levels of significance. The correlations of the interaction scores with the dependent variable are all low and nonsignificant.

It is also informative to observe certain of the intercorrelations of the independent linear variables, shown in Table XIX. First, it should be observed that anxiety correlates negatively and significantly with pretest criterion scores (r = -.52), verbal IQ (r = -.46), imagination (-.24), originality (-.24) and fluency (-.23). These data indicate that, for this sample, there is a moderately strong tendency for Ss with high anxiety scores to have lower verbal IQ scores and a lower level of achievement in the concepts taught by the program before beginning the instructional condition.

The measures (linear) of achievement and ability are all positively intercorrelated and, as shown in Table XIX, are also positively correlated with the dependent variable. Verbal IQ correlates positively and significantly with pretest criterion scores (r = .63), imagination scores (r = .44), flexibility scores (r = .18), originality scores (r = .33) and fluency scores (r = .37). The correlations of the creativity subtest scores with pretest criterion scores are as follows: .45 for imagination, .18 for flexibility, .26 for originality and .33 for fluency. All of the above correlations are significant.

The correlations of sex with the independent and dependent variables shown in Table XIX, indicate that the inclusion of sex

Table XVIII

Means and Standard Deviations of the Standardized Independent Linear Variables, the Interaction Terms and the Standardized Criterion Variable

(N = 165)

Type of Variable	Variable Number*	Variable Name	X	SD
Dependent	1	Posttest Criterion	.00	1.00
Control	2	Sex	.03	1.00
Independent	3	Lorge-Thorndike Verbal IQ	.00	1.00
Independent	4	Imagination Subtest	.00	1.00
Independent	5	Flexibility Subtest	.00	1.00
Independent	6	Originality Subtest	.00	1.00
Independent	7	Fluency Subtest	.00	1.00
Independent	8	$\text{TASC}_{\text{adj.}}$	.00	1.00
Control	9	Pretest Criterion	.00	1.00
Independent	10	(Imagination x $\text{TASC}_{\text{adj.}}$)	-.24	1.08
Independent	11	(Flexibility x $\text{TASC}_{\text{adj.}}$)	-.08	1.12
Independent	12	(Originality x $\text{TASC}_{\text{adj.}}$)	-.24	1.34
Independent	13	(Fluency x $\text{TASC}_{\text{adj.}}$)	-.23	.96
Independent	14	(IQ x $\text{TASC}_{\text{adj.}}$)	-.46	1.10
Independent	15	(Imagination x IQ)	.44	1.13
Independent	16	(Flexibility x IQ)	.18	1.08
Independent	17	(Originality x IQ)	.33	1.34
Independent	18	(Fluency x IQ)	.36	1.01

*Identifies the number of each variable in the regression analyses.

Table XIX

Intercorrelations of the Independent and Dependent Variables Used in the Step-Wise Regression*

	Posttest Criterion 1	Sex 2	Lorge-Thorn IQ 3	Imagination Subtest 4	Flexibility Subtest 5	Originality Subtest 6	Fluency Subtest 7	TASC$_{adj.}$ 8	Pretest Criterion 9	(Imagination x TASC$_{adj.}$) 10	(Flexibility x TASC$_{adj.}$) 11	(Originality x TASC$_{adj.}$) 12	(Fluency x TASC$_{adj.}$) 13	(IQ x TASC$_{adj.}$) 14	(Imagination x IQ) 15	(Flexibility x IQ) 16	(Originality x IQ 17	(Fluency x IQ) 18
1	----																	
2	-.11	----																
3	.74	.01	----															
4	.43	.01	.44	----														
5	.21	.10	.18	.30	----													
6	.21	.06	.33	.39	.28	----												
7	.38	-.07	.37	.36	.25	.40	----											
8	-.53	.18	-.46	-.24	-.08	-.24	-.23	----										
9	.75	-.18	.63	.45	.18	.26	.33	-.53	----									
10	-.14	.05	-.22	-.18	-.13	-.32	-.14	.15	-.24	----								
11	-.04	.04	-.09	-.13	-.01	-.23	-.12	.01	-.02	.45	----							
12	-.10	-.01	-.21	-.25	-.19	-.61	-.23	.15	-.15	.55	.47	----						
13	-.12	-.01	-.22	-.16	-.13	-.32	-.17	.02	-.18	.45	.55	.60	----					
14	-.06	.17	-.10	-.22	-.09	-.26	-.19	.04	-.15	.57	.39	.34	.38	----				
15	-.06	-.18	.14	.19	.09	.30	.12	-.21	.15	-.55	-.37	-.42	-.33	-.49	----			
16	.01	-.00	.05	.10	.10	.19	.05	-.09	.11	-.39	-.53	-.33	-.32	-.34	.53	----		
17	.09	.02	.20	.25	.15	.65	.22	-.21	.20	-.46	-.33	-.80	-.48	-.38	.54	.36	----	
18	.13	-.03	.14	.13	.05	.30	.20	-.21	.17	-.34	-.31	-.45	-.57	-.37	.47	.36	.54**	----

*All linear variables are in z score form.

**A r of .16 is significant at the .05 level (two-tail).

Table XX

Zero Order Correlations of the Predictor Variables with the Criterion

(N = 165)

Variable No.	Predictor Variable	r_{z_1}*
9	Pretest Criterion	.75
3	Lorge-Thorndike IQ	.74
8	$\text{TASC}_{\text{adj.}}$	-.53
4	Imagination Subtest	.43
7	Fluency Subtest	.38
5	Flexibility Subtest	.21
6	Originality Subtest	.21
10	Imagination x $\text{TASC}_{\text{adj.}}$	-.14
18	Fluency x IQ	.13
13	Fluency x $\text{TASC}_{\text{adj.}}$	-.12
2	Sex	-.11
12	Originality x $\text{TASC}_{\text{adj.}}$	-.10
17	Originality x IQ	.09
15	Imagination x IQ	-.06
14	IQ x $\text{TASC}_{\text{adj.}}$	-.06
11	Flexibility x $\text{TASC}_{\text{adj.}}$	-.04
16	Flexibility x IQ	.01

*An r of .16 is significant at the .05 level (two-tail).
An r of .21 is significant at the .01 level (two-tail).

as a possible control variable was unnecessary. Only four of the correlations of sex with the other variables are significant, with the highest correlation attaining a value of .18.

The striking thing about the correlational data is that they in no way appear to fit the theory discussed in the introduction. The negative correlation of anxiety with the dependent variable is comparable in value and direction to the correlations of questionnaire anxiety and academic performance criteria found by other investigators with samples of upper grade elementary students (15, 26, 32, 45). Also inconsistent with expectations are the positive correlations of the creativity subtests with the dependent variable, and the high positive correlation of verbal IQ with the dependent variable.

Results of the Step-Wise Regression Procedure

The results of the step-wise regression procedure have been reproduced directly from computer output and are shown in Table XXXII in Appendix H. The final step of the step-wise regression procedure contained all 17 of the predictor variables, indicating that each of the predictors increased the multiple correlation in excess of a minimum of .001.

Table XXI summarizes the results of the tests of significance applied to the regression coefficients of the predictors in each of the 17 regression equations. The multiple correlation (R) and the coefficient of multiple determination (R^2) are indicated for the separate regression equations. These data show that after step four the regression coefficients of the predictors added to the regression equation at subsequent steps were all nonsignificant. With the exception of the variable added at step four (variable 17), the regression coefficients for the other variables in step four (variables 3, 8 and 9) remained significant with all independent variables entered in the regression equation (i.e., at step 17). The gain in prediction from step four to step 17 is indicated by the difference in R^2 for the two regression equations. For step four R^2 is .704, and for step 17 R^2 is .724, indicating that an additional two percent of the criterion variance is accounted for by adding the remaining 14 predictors to the regression equation.

From the data shown in Table XXI, it may be concluded that variables 3, 8, 9 and 17, when combined in a multiple regression equation, appear to contribute uniquely and significantly to the prediction of the criterion. The remaining predictors, when combined with variables 3, 8, 9 and 17 in the multiple regression equation, apparently make no unique contributions to the prediction of the criterion that are not accountable to chance factors. The most parsimonious statement of the variables which contribute uniquely and significantly to the prediction of the criterion is thus expressed by the multiple regression equation obtained for step four.

Relative Contributions of the Independent Variables

The results of the first four steps of the step-wise regression procedure are shown in Table XXII. Beginning at the left, the first two columns identify the steps in the regression procedure, and the independent variable added to the regression equation at each step. The next three columns show the beta weights (B), the regression coefficients (b), and the sampling errors of the regression coefficients ($\hat{SE}_b$). Subsequent columns show: (1) the approximate significance level for the regression coefficients of the independent

Table XXI

Significance of the Beta Weights of the Predictor Variables Indicated for Each Step of the Step-Wise Regression Procedure

(N = 165)

Step Number	Variables in the Regression Equations Identified by Number+	Mult. R.	R^2
(1.)	9*	.750	.562
(2.)	9*,3*	.828	.685
(3.)	9*,8*,3*	.833	.693
(4.)	17*,9*,8*,3*	.839	.704
(5.)	17*,9*,8*,7, 3*	.843	.710
(6.)	17*,9*,8*,7,5,3*	.844	.712
(7.)	17,9*,8*,7,6,5,3*	.845	.714
(8.)	17,15,9*,8*,7,6,5,3*	.846	.716
(9.)	17,15,11,9*,8*,7,6,5,3*	.847	.718
(10.)	17,16,15,11,9*,8*,7,6,5,3*	.848	.719
(11.)	17,16,15,11,9*,8*,7,6,5,4,3*	.849	.720
(12.)	18,17,16,15,11,9*,8*,7,6,5,4,3*	.849	.721
(13.)	18,17,16,15,13,11,9*,8*,7,6,5,4,3*	.850	.723
(14.)	18,17,16,15,14,13,11,9*,8*,7,6,5, 4,3*	.851	.724
(15.)	18,17,15,14,13,11,9*,8*,7,6,5,4, 3*,2	.851	.724
(16.)	18,17,16,15,14,13,11,10,9*,8*,7,6, 5,4,3*,2	.851	.724
(17.)	18,17,16,15,14,13,12,11,10,9*,8*, 7,6,5,4,3*,2	.851	.724

*Significant regression weights, with P set at .05 (two-tail).

+Variables added to the regression equation at each step are underlined.

variables in each regression equation; (2) the multiple correlation (R) for each regression equation; (3) the coefficient of multiple determination (R^2), or the percent of the total criterion variance predicted by each multiple regression equation; and (4) the standard error of estimate Y (SE Y), which is the standard error of the residuals of the predicted standardized criterion scores.

It will be seen that the order of selection of the first three predictor variables for the multiple regression equation parallels

Table XXII

Summary of the Results of the First Four Steps of the Step-Wise Regression Procedure

Step No.	Independent Variable(s)	B	b	SE b	df	t-ratio+ b	Sig. Level-b	R	R^2	SE Y
1	Pretest Criterion++	.750*	.750	.052	163	14.48	< .002	.750	.562	.664
2	Pretest Criterion Lorge-Thorn.++	.466	.466	.057	162	8.20	< .002	.828	.685	.565
	Verbal-IQ	.451	.451	.057	162	7.94	< .002			
3	Pretest Criterion Lorge-Thorn.	.424	.424	.060	161	7.11	< .002	.833	.693	.558
	Verbal-IQ	.426	.426	.057	161	7.42	< .002			
	$TASC_{adj.}$ ++	-.111	-.111	..052	161	2.13	< .05			
4	Pretest Criterion Lorge-Thorn.	.431	.431	.059	160	7.34	< .002	.839	.704	.551
	Verbal-IQ	.436	.436	.057	160	7.69	< .002			
	$TASC_{adj.}$	-.125	-.125	.052	160	2.42	< .02			
	(Originality x Verbal-IQ)++	-.106	-.079	.033	160	2.37	< .02			

*All figures rounded to three places.
+All tests are two-tailed.
++Variable entered at each step.

the relative magnitudes of the zero order correlations of these predictors with the criterion. The beta weights given in step four for verbal IQ (.436) and pretest criterion (.431) indicate that these variables are of approximately equal importance as contributors to the prediction of the criterion. The weight for anxiety (-.125) is negative and proportionately smaller, with the ratio being roughly 1.0:3.5, relative to the comparable weights given for pretest criterion and verbal IQ.

The addition of the interaction of originality and IQ to the regression equation at step four is an unexpected outcome of the analysis, since it will be recalled that the interaction terms have near zero validities with the criterion. This outcome may be explained and clarified through consideration of the correlations of the interaction term with the remaining predictors in step four, and by contrasting the weights given for these predictors in steps three and four. Table XIX shows that the interaction term correlates higher with verbal IQ (.20), pretest criterion (.20), and anxiety (-.21), than it correlates with the criterion (.09). By contrasting the beta weights of the predictors in the regression equations shown for steps three and four in Table XXII, it will be observed that the negative weight given to the interaction term in the regression equation shown for step four, has the effect of producing slight increases in the weights given to the remaining predictors.

These data, taken together, indicate that the interaction term adds to the validity of the multiple regression equation shown for step four by acting as a suppressor (Cf. 12, pp. 8-13; 34, pp. 186-187). Its apparent function is to subtract from each of the remaining predictors, a very small part of their "nonvalid" variances, thus producing a small increase in the criterion correlation of the combined predictors. Although any further explanation of the function(s) of the interaction term in the regression equation shown for step four will not be hazarded, it seems safe to conclude that this variable does not contribute directly to the prediction of the dependent variable.

The relative extent of the contributions of the predictor variables, when combined in the multiple regression equation shown for step four, may also be indicated by expressing the contribution of each predictor as a proportion of the total variance of the criterion (23). Table XXIII shows the direct, indirect and the total (combined direct and indirect) contributions of the predictors, expressed as proportions of the total variance of the standardized criterion scores (z_1).

The B-r products give indications of the combined direct and indirect contributions of the predictors. From these it may be seen

Table XXIII

Direct and Indirect Contributions of the Predictor Variables Expressed as Proportions of the Total Variance of the Criterion

(N = 165)

Predictor Variable	r_{z_1}	B	Direct Direct B^2	Indirect $B r_{z_1} - B^2$	Direct & Indirect $B r_{z_1}$
(z_3) Verbal IQ	.74	.436	18.01%	13.25%	32.26%
(z_8) Anxiety	-.53	-.125	1.56%	5.07%	6.63%
(z_9) Pretest Criterion	.75	.431	18.58%	13.75%	32.33%
Total Predicted Variance of z_1					71.22[1]

that the total proportions of variance accounted for are approximately 32 percent for verbal IQ, 6.6 percent for anxiety and 32 percent for pretest criterion.

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[1] This figure differs slightly from the corresponding figure given in Table XXII, due to rounding errors.

Since pretest criterion scores were included as a control over initial knowledge of the learning material, the figures given for verbal IQ and anxiety indicate that approximately 39 percent of the total criterion variance is attributable to two of the relevant independent variables.

The figures shown for B and B^2 are essentially equivalent measures of the relative importance of each of the predictors, when combined in the multiple regression equation shown for step four. The squares of the beta coefficients indicate the direct or unique contributions of the predictors, expressed as proportions of the total criterion variance. These figures show that the direct contributions of the predictors are approximately 19 percent for verbal IQ, 1.6 percent for anxiety and 18.6 percent for pretest criterion.

The indirect contributions in column five are obtained from the B-r products minus the direct contributions, or as shown -- $B_{r_{z_1}} - B^2$. The indirect contributions for each predictor are approximately 13 percent for verbal IQ, five percent for anxiety and 13.4 percent for pretest criterion.

The total proportion of the criterion variance accounted for by the combined predictors, verbal IQ, anxiety, pretest criterion, and the interaction of originality and IQ, is slightly in excess of 70 percent. The multiple correlation for this combination of predictors is .839. Using a table provided by Guilford (23, 580-81), it was determined that a multiple correlation of .290 is significant at the .01 level (with $n = 5$ and 150 degrees of freedom). Thus the obtained multiple correlation of .839 is highly significant.

The cross-validity of the sample multiple correlation may be estimated by the Wherry Shrinkage Formula (58). Applying this formula, the resultant R^2 was .6965, and the square root of this yields a value of .834, or R corrected for shrinkage. Thus a maximum estimate of the expected shrinkage is .839 - .834, or .005.[1]

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[1] The Wherry shrinkage formula is intended to estimate the cross-validity of a sample multiple regression equation. However, it is well known that the Wherry procedure corrects for only part of the shrinkage which might be expected if the equation were cross-validated.

The Wherry shrinkage formula is:

$${}_{s}R^2 = 1 - \frac{N-1}{N-n-1}\ (1-R^2)$$

3.2: The Effects of Learning From a Linear, Constructed-Response Style Program on the Verbal Creativity Test-Gains of Learners

The basis for this aspect of the research was given briefly in the introductory Section as follows:

> .... it is ... possible that experience with programed instruction may habituate the S to more rigid and convergent modes of thinking due to the continuous practice and reinforcement in this type of thinking provided by the program. This would suggest that eventually some type of interference with divergent or creative modes of thinking would accrue, with the possible outcome of a temporary reduction in the S's creative verbal expression.

This concern derives from the recent emphasis in research and theory on the conditions which lead to the development of creativity in the school situation (51, 53, 54). In a previous paper, Wodtke and Wallen (57) described certain classroom conditions which may affect the development of creative verbal expression. These authors believe that certain types of teacher behaviors have a negative effect on the creative thinking abilities of students, whereas others have a positive or facilitating effect. Facilitation is presumably associated with tolerance for the unusual ideas of students and the maintenance of a classroom atmosphere of permissiveness and respect with regard to the individualized contributions and activities of students. On the other hand, teachers who exercise a high degree of control and directiveness over student's responses and activities in the classroom would be expected to affect their student's creative thinking scores in the opposite direction. In this view, the classroom conditions which lead to the development of creativity essentially include the creation of opportunities for unusual or individualized verbal expressinn, coupled with reinforcement for this type of expression. It is also easy to see how a teacher may extensively guide and initiate the student's thoughts and activities and reinforce him only for convergent modes of thinking.

The conceptualization described here was supported in a comparison of the creativity gain scores of fourth and fifth graders whose teachers were identified as either high or low on the teacher control dimension. Both teacher control and the amount of time the students spent with their teachers seemed to be important factors in whether the students registered significant gains in verbal creativity over the six month duration of the research.

Analagous to the highly controlling teacher described by Wodtke and Wallen, the typical linear style program rigidly controls the *S*'s thoughts and responses. Original or divergent thinking is effectively precluded for the *S* while responding appropriately to the program, and the *S* is continuously reinforced for making the appropriate or expected response. Given the practice and success in *convergent* modes of thinking and responding induced through attending to the program, it might be expected that this would interfere with the *S*'s subsequent performance on tests of creativity. The extent of this interference would seem to depend largely upon the type of program experienced by the *S*, and the amount and continuity of the experience.

Design

As described in the discussion of the overall design of the research effort, two groups of classes -- one programed and one non-programed -- were formed for the purpose of evaluating the effects of programed instruction on the creativity scores of learners. The design of this aspect of the research (shown previously in Table VII, page 22) may be illustrated by the following:

$$\begin{array}{llll} R & O_1 & X & O_2 \\ R & O_3 & & O_4 \end{array}$$

in which X is the programed treatment, the R's indicate random assignment of classes to treatments (classes are treated as individuals), and the O's indicate the pre- and post-test measures of verbal creativity taken on the groups with an interval of approximately two weeks between administrations. The number of classes in each group is four. The hypothesis tested is whether the group not receiving the treatment (controls) obtains significantly higher verbal creativity gain scores than the experimental group at the end of the instructional period, and after adjustment for differences in pretest and IQ.

Subjects

The sample was composed of the initial control group of four sixth-grade classes described in Section 2.2, plus four classes selected randomly from among the nine classes assigned to the programed condition for the main part of the research. It will be recalled that both the programed and control classes were initially assigned at random to the programed and control conditions. Table XXIV identifies the experimental and control classes by sex and number in each class, school system and individual school. From these data it may be seen that the total number of *S*s and the distribution of sexes are approximately equivalent within and between the experimental and control groups. School systems, and thus the general program of study, are equated within and between groups. However, it should be noted that each of the classes within the experimental and control groups are supervised by a different teacher during the course of the experiment.

Table XXIV

Sex Distributions Within School Systems and Within Classes for the Experimental and Control Groups

Experimental Classes

Class Number	Boys	Girls	Total	System	School
111	11	8	19	Hornell	Lincoln
511	10	10	20	Hornell	Washington
721	10	9	19	Corning	Kent Phillips
911	5	9	14	Corning	Painted Post
Totals	36	36	72		

Control Classes

Class Number	Boys	Girls	Total	System	School
132	8	15	23	Hornell	Lincoln
212	13	9	22	Hornell	Irving
612	8	8	16	Corning	Winfield
712	11	5	16	Corning	Kent Phillips
Totals	40	37	77		

Materials and Procedures.

The teachers of the control classes proceeded with their normal courses of instruction, which did not include any experiences with programed materials. It was further ascertained that the courses of instruction of both the programed and control teachers did not include systematic instruction in creative verbal activities.

The programed experience, as described earlier, consisted of one-half hour of instruction daily for a two-week period from the program, Latitude and Longitude. The program is a typical linear, constructed-response type program, wherein the S's responses are continually controlled and shaped toward a specified criterion. This type of program, as contrasted with other types of programed materials (Cf. 36) and conventional teacher presentation, is relatively extreme in the degree of restriction and control imposed upon the learner's thoughts and responses.

The design and procedure used for this aspect of the research thus assures that the experimental and control classes received contrasting amounts of experience with the restrictiveness and control imposed by the program. However, the extent of this experience is relatively short, totalling only about five hours over the two-week course of the research.

Measures

The schedule of testing for both the experimental and control groups and the scoring procedures for the creativity battery have been presented previously. As a check on the equivalence of the treatment groups, pretest means on the creativity battery and on the IQ test were compared for the experimental and control classes. As shown in Table XXV, relatively slight differences between the experimental and control groups were obtained on the subtest scores in the creativity battery and for total creativity score. The largest mean difference between groups exists for total scores (E - C = .30). Mean IQ scores for the combined experimental and control groups are respectively, 109.8 and 105.6. The mean difference between the groups does not reach significance (t = 1.84, p = .10).

Table XXVI shows the correlation coefficients of the scores obtained from the pretest administration of the creativity battery with those obtained from the posttest administration of the creativity battery, given approximately two weeks later. Although equivalence of groups had been obtained on pretest scores as shown in Table XXV above, the correlations between pretest and posttest scores for the combined treatment groups are not sufficiently high to justify the use of a straight difference score as a measure of gain (Cf. 14, p. 295). Based on these findings and the lack of equivalence between groups in IQ scores, it was decided to use residual-gain scores as dependent variables in the analyses, using both the Ss' pretest scores and IQ scores as "control" variables.

Residual-gain scores on the creativity measures were computed by a variant of a procedure described by Wodtke and Wallen (57). Within the experimental and control groups combined, scores on the

Table XXV

Pretest Means and Standard Deviations of the Creativity Subtests, Total Creativity, and IQ for the Experimental and Control Groups

Test	Classes									
	Experimental					Control				
	111	511	721	911	Total	132	212	612	712	Total
Pre-Tests										
Imag.										
$\overline{X}$	5.74	5.20	6.84	5.71	5.88	5.30	5.86	5.50	6.31	5.71
SD	1.73	2.29	2.91	1.73	2.29	1.64	2.12	1.37	3.22	2.14
Flex.										
$\overline{X}$	3.79	3.70	5.57	6.00	4.67	3.61	5.36	5.31	4.75	4.70
SD	2.49	2.00	2.29	3.31	2.65	2.55	2.98	1.89	1.48	2.46
Orig.										
$\overline{X}$	1.53	0.40	1.63	1.57	1.25	0.30	2.55	0.94	0.94	1.21
SD	1.43	0.82	2.29	2.28	1.81	0.70	2.46	0.85	1.61	1.81
Flu.										
$\overline{X}$	5.42	4.50	5.16	5.21	5.06	3.74	6.23	5.31	4.75	4.99
SD	3.01	3.02	2.97	2.81	2.92	3.12	4.43	1.70	3.84	3.56
Total										
$\overline{X}$	16.50	13.80	19.20	18.50	16.90	13.00	20.00	17.10	16.80	16.60
SD	5.98	5.58	8.36	6.26	6.90	5.50	6.52	3.51	7.20	6.40
IQ										
$\overline{X}$	110.10	107.70	111.80	109.50	109.80	102.00	108.20	103.80	109.00	105.60
SD	15.37	12.23	15.06	11.00	13.50	11.84	13.17	15.74	15.71	13.97

Table XXVI

Correlations Between Pretest Creativity Scores and Posttest Creativity Scores

	Subtest	Experimental	N	Control	N	Groups Combined	N
1.	Imagination	.52	(72)	.19	(77)	.35	(149)
2.	Flexibility	.73	(72)	.52	(77)	.63	(149)
3.	Originality	.51	(72)	.43	(77)	.45	(149)
4.	Fluency	.62	(72)	.34	(77)	.46	(149)
5.	Total Score	.73	(72)	.57	(77)	.65	(149)

creativity pretest and the IQ test were intercorrelated. This was done for each subtest separately. A posttest score for each S on each subtest was then predicted employing a step-wise multiple regression procedure, using the S's score on the creativity pretest and the intelligence test as predictors and based on intercorrelations within the combined experimental and control groups. An F-level of 2.30 ($p = .10$) was indicated for each regression case (i.e., the regressions for each subtest) empirically specifying the level at which a variable would be maintained as a predictor. Essentially, the procedure is the same as that described for the major part of this study, with the exception that only two predictor variables were entered, and the use of F-level specifying the significance level below which a variable was to be removed or added.

Raw scores were used for input data. The predictor variables for each regression equation were the S's pretest score on a creativity subtest and his score on the IQ test. The creativity pretest was selected as the first entered variable in each regression case ($F > 2.30$). With the exception of the regression case for subtest one (imagination), the F's for IQ were greater than 2.30 in the second step of the regression cases where both predictor variables were entered. Thus, the predicted posttest scores were calculated on the basis of both pretest score and IQ score for the last three creativity subtests (flexibility, originality and fluency) and total creativity score. The predicted posttest scores for the imagination subtest were calculated with only pretest score as a predictor variable.

Each S's residual-gain score was then computed for each subtest and for total creativity score by subtracting his predicted posttest score from his obtained posttest score. This procedure adjusts each observed posttest score on a given creativity subtest for the score on the intelligence test and on the pretest (with the exception of the imagination subtest where the adjustment was made for pretest only).

A S's residual-gain score thus represents the distance that his observed posttest score deviates from the multiple regression plane. It is a function of experimental error and treatment effects. The residual-gain scores computed for each S were then used to calculate mean residual-gain scores by class for each creativity subtest and total creativity score. These scores were then used as dependent variables in one-way analyses of variance, comparing the mean residual-gains of the experimental and control classes for each creativity subtest and total creativity score.

Results

The statistic used for analyzing the residual-gain scores from the creativity battery is a simple-randomized analysis of variance of the unweighted means of the treatment classes (29, p. 177). This analysis is appropriate when intact classes have been randomly assigned to the treatments (4, p. 193; 29, p. 177). Unweighted mean residual-gain scores were computed for each subtest in the creativity battery and for total creativity score for each of the four classes which comprised the treatment groups. Five one-way analyses of variance compared the mean residual-gains on the creativity subtests and for total creativity made by the classes in the programed instructional condition with those made by the classes not receiving programed instruction. The results of these analyses are presented in Table XXVII.

None of the F's for the analyses presented in Table XXVII approached significance. Table XXVIII shows the means and variances of the residual-gain scores of the creativity subtest and total creativity score for the experimental and control classes. The residual-gains of the experimental group are negative for the subtests imagination and originality, and for total score. In contrast, the control group obtained a negative residual-gain score on only one subtest (fluency). The residual-gain for total score is positive.

The results offer no support for the hypothesis that learning from a linear style, constructed-response program for one-half hour

Table XXVII

Summary of Analyses of Variance for Five Verbal-Creativity Residual-Gain Scores

	Imagination*				
Source	df	SS	MS	F	p
Treatments	1	1.01	1.01	2.81	n.s.
Within groups (error)	5	1.78	.36		
Total	6	2.79			

	Flexibility				
Source	df	SS	MS	F	p
Treatments	1	.01	.01	<1	-
Within groups (error)	4	1.21	.30		
Total	5	1.22			

	Originality				
Source	df	SS	MS	F	p
Treatments	1	.60	.60	2.32	n.s.
Within groups (error)	4	1.04	.26		
Total	5	1.64			

	Fluency				
Source	df	SS	MS	F	p
Treatments	1	.12	.12	<1	-
Within groups (error)	4	9.49	2.37		
Total	5	9.62			

	Total Score				
Source	df	SS	MS	F	p
Treatments	1	2.24	2.24	<1	-
Within groups (error)	4	9.64	2.41		
Total	5	11.88			

*The residual-gain score for imagination was computed using pre-test only as a predictor. Thus, this analysis of variance has one more degree of freedom than the other analyses where two predictors (IQ and pre-test) were used to compute residual gain scores.

Table XXVIII

Means and Variances of Residual-Gain Scores by Creativity Subtest and Total Creativity Score for the Experimental and Control Groups*

		Experimental		Control	
		$\overline{X}$	s^2	$\overline{X}$	s^2
1.	Imagination	-.390	.241	.320	.204
2.	Flexibility	.015	.110	.068	.194
3.	Originality	-.300	.052	.250	.207
4.	Fluency	.150	1.375	-.100	.998
5.	Total Score	-.520	1.956	.540	.460

*Based on class means (N = 4 for each group).

a day over a period of two weeks has a negative effect on sixth grader's verbal creativity scores.

SECTION 4

SUMMARY AND DISCUSSION

Overall Design of the Research

The overall research effort was composed of four distinct parts. The major focus of the research was directed at ascertaining the importance of sixth grader's verbal intelligence, verbal creativity, and anxiety scores (and their interactions), as contributors to their achievement with programed instructional materials. An investigation of the effects of learning from programed instructional materials on the verbal creativity scores of sixth graders was pursued simultaneously with the evaluation of the previous objectives. The research also included: (1) a pilot phase which was concerned with the development of a criterion test for measuring the amount of learning from the program, and (2) an effort to ascertain the validity of the anxiety score used in the research.

Seventeen sixth-grade classes comprising a total of 388 boys and girls participated in the overall research effort. Four sixth grade classes, totalling 84 pupils in all, participated in the pilot phase of the research. The remaining 13 classes had been selected to be roughly equivalent in range of intellectual ability, sex, curriculum and previous experience with programed instruction. These classes were then randomly assigned to two conditions, with nine classes assigned to the programed learning condition and four classes to a control condition. The nine classes in the programed condition (totalling 165 boys and girls) were the subjects for the major focus of the research. Four classes (totalling 72 boys and girls) were selected randomly from these nine classes to be compared with the four control classes (totalling 77 boys and girls) for the purpose of evaluating the effects of programed instruction on the verbal creativity scores of learners.

The learning materials used in the programed phase of the research were copies of a commercially prepared program, Latitude and Longitude (25). Subjects in the programed condition studied the program for one-half hour per day for a two-week period under teacher supervision.

Prior to the initiation of instruction subjects in the programed condition were given the following tests:

(1) The Test Anxiety Scale for Children (TASC).
(2) The Lie Scale for Children (LSC).
(3) A verbal creativity battery with four subtest scores measuring imagination, flexibility, originality and fluency.

(4) Lorge-Thorndike Verbal IQ (Level-III, Form-A).
(5) A criterion test constructed to measure knowledge of the learning material taught by the program.

The anxiety score used in the research consisted of a combination of the S's TASC score and his weighted LSC score. This score was referred to as an adjusted TASC score ($\text{TASC}_{\text{adj.}}$).

Subjects in the programed condition were readministered the TASC, LSC, the creativity battery, and the criterion test at the conclusion of instruction. Control Ss (non-programed) were given the verbal IQ test, the LSC, TASC and the creativity battery prior to the initiation of the program, and were again given the TASC, LSC and the creativity battery at the conclusion of instruction. The scores from the two administrations of the criterion test were designated pretest criterion and posttest criterion.

The reliabilities of the scores on the independent and dependent variables for the 165 programed Ss were: .91 (split-half) and .75 (two-week, test-retest) for the criterion test; .66 (two-week, test-retest) for $\text{TASC}_{\text{adj.}}$; and .39 for imagination, .55 for flexibility, .59 for originality, and .65 for fluency (all two-week, test-retest). The two-week, test-retest reliabilities of the creativity subtest scores and total creativity scores for the combined eight programed and control classes were: .35 for imagination, .63 for flexibility, .45 for originality, .46 for fluency, and .65 for total creativity.

Results of the Pilot Study

Based on the data obtained in the pilot study, an item analysis of two forms of the criterion test was conducted. These two criterion test forms were administered to 84 sixth graders who had received the programed instruction. This procedure resulted in a final criterion test of 50 items with a mean discrimination index of 49.28 percent and a mean difficulty level of 51.16 percent.

Results of the Analyses of Sixth Graders' Anxiety Scores

In one analysis, TASC, LSC and $\text{TASC}_{\text{adj.}}$ scores were correlated with criterion test and verbal IQ scores. In the second analysis, teacher's rankings of children's anxiety were correlated separately with sixth graders' TASC, LSC and $\text{TASC}_{\text{adj.}}$ scores. In both analyses the validity coefficients of TASC and $\text{TASC}_{\text{adj.}}$ scores were compared with the intent of selecting the more valid anxiety score.

In the first analysis, correlations of TASC scores with pretest criterion, posttest criterion and verbal IQ scores were respectively: -.26 ($p < .005$), -.28 ($p < .005$), and -.26 ($p < .005$). For the combined TASC-LSC score ($TASC_{adj.}$) the correlations with pretest criterion, posttest criterion, and verbal IQ scores were respectively: -.52 ($p < .005$), -.53 ($p < .005$) and -.46 ($p < .005$). The values of the correlations of $TASC_{adj.}$ scores with pretest criterion, posttest criterion, and verbal IQ scores were shown to be significantly higher than were the correlations of TASC scores with the same measures.

For the second analysis, eight of the teachers participating in the programed phase of the research ranked the children in their classrooms with respect to a definition of school anxiety (39). Correlations of LSC, TASC, and $TASC_{adj}$, scores with teacher rankings of anxiety (TR scores) were then computed separately for each class. Using Fisher's z transformation (34), the correlations of LSC, TASC and $TASC_{adj.}$ scores with TR scores were then averaged across the eight classes. The resultant averaged correlations of LSC, TASC and $TASC_{adj.}$ scores with TR scores were respectively: -.13 ($p > .05$), -.33 ($p < .005$), and -.31 ($p < .005$).[1] These data showed that, on the average, there was no tendency for $TASC_{adj.}$ scores to correlate at a higher level with teacher rankings of anxiety than TASC scores alone. Examination of the correlations of LSC, TASC and $TASC_{adj.}$ scores with TR scores within individual classes indicated a slight but statistically unreliable tendency for $TASC_{adj.}$ scores to correlate at a higher level with TR scores than TASC scores alone. This tendency was noted in only three of the eight classes. The results of this and the previous analysis were considered sufficient justification for selecting the $TASC_{adj.}$ score as the measure of anxiety for use in other aspects of the research.

Some comment on the validity study of the $TASC_{adj.}$ score is in order. In research reported by Hill and Sarason (26), partial correlation was employed as a procedure in correcting for the tendency of elementary school children to distort their TASC scores. In the present study, this distortion was corrected for by adjusting the Ss' LSC scores to have the same variance as their TASC scores. The adjusted LSC scores and the TASC scores were then combined to obtain the $TASC_{adj.}$ scores. The results of this study of the validity of the $TASC_{adj.}$ score are substantial enough to warrant additional investigations directed at further ascertaining the construct validity of this score as a measure of anxiety. An additional direction for future research might involve the development of different methods of weighting each component of the $\text{TASC}_{\text{adj.}}$ score. In this way further improvements in the predictive validity of the $\text{TASC}_{\text{adj.}}$ score for academic and intellectual performance criteria might be obtained.

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[1] A negative correlation between TR scores and LSC, TASC and $TASC_{adj.}$ scores indicates positive agreement.

Analysis of the Effects of Learning with Programed Instructional Materials on the Verbal Creativity Residual-Gain Scores of Learners

In general, the typical programed instructional sequence guides and controls the learner's thoughts and responses in a manner analogous to the *channeling* and *control* involved in *convergent thinking* described by Guilford (22). It was reasoned that experience with programed materials might habituate the *S* to rigid and convergent modes of thinking and responding through the continuous practice and reinforcement provided for this type of thinking and responding. It was thought that this type of learning experience might have a deleterious effect on the *S*'s subsequent performance on tests of verbal creativity.

Four of the classes which received the two-week experience with the *Latitude and Longitude* program (in addition to the normal course of instruction) and four classes which received the normal course of instruction (but not the programed instruction) were used in this phase of the research. The classes were randomly assigned to the programed and nonprogramed conditions. The hypothesis tested was whether the group which did not receive the programed treatment (controls) obtained significantly higher verbal creativity residual-gain scores than the programed group (experimental) at the conclusion of the instructional period.

Residual-gain scores, using pretest scores on the verbal creativity battery and verbal IQ scores as "control" variables, were computed for the *Ss* in the experimental and control classes for *flexibility*, *originality*, *fluency* and *total creativity*. Residual-gain scores on the *imagination* subtest were calculated using only pretest scores on this subtest as a "control" variable. The residual-gain scores for each *S* were then used to calculate mean residual-gain scores by class, for each creativity subtest and for total creativity. These scores served as dependent variables in five one-way analyses of variance comparing the mean residual-gains made by the classes in the programed and control conditions.

None of the F-ratios in the five analyses of variance approached significance. However, the mean residual-gains for the experimental group were negative for *imagination*, *originality* and *total creativity*, whereas the control group obtained a negative mean residual-gain only for *fluency*. For *flexibility*, the mean residual-gain of the control group was slightly larger than the mean residual-gain obtained by the experimental group. Thus the results, although nonsignificant, were generally in the predicted direction.

In viewing these findings, two major limitations of this aspect of the research should be noted:

(1) The reliabilities of the creativity subtest scores were relatively low, especially for imagination.

(2) The period of the learner's exposure to the program was of relatively short duration, comprising only about one-twelfth of the school day, and a very small fraction of the school year.

In a study which bears on this part of the research, Wodtke and Wallen (57) suggested that the amount of time pupils spent with their teachers appeared to be an important factor in determining whether teacher control had an effect on students' verbal creativity gains. The fourth and fifth grade teachers identified as high and low controlling in the Wodtke and Wallen study were the students' homeroom teachers. The fourth graders spent their entire day with their homeroom teachers. Three of the five classes of the fifth-grade group spent only one-and-one-half hours per day with their homeroom teachers. The period between administrations of the pre- and post-creativity tests was approximately six months. Significant differences for verbal flexibility and total verbal creativity, favoring the pupils of low controlling teachers, were obtained in the analyses of fourth graders' creativity scores. One significant difference on a measure of nonverbal creativity favored the high controlling teachers at the fifth grade level. If teacher control and the control in programed materials are comparable, then it might be expected that a longer period of exposure to learning with programed instruction than was accomplished in the present study would result in a reduction in verbal creative production. This remains a possibility for future studies.

The Analysis of the Contributions of Anxiety, Creativity, Verbal IQ and the Interactions of Anxiety, Creativity and Verbal IQ, to Achievement with Programed Instructional Materials

A logical analysis relating the characteristics of programed instructional materials to anxiety, verbal creativity, and verbal IQ of learners led to the following expectations: (1) school anxiety would make a small positive contribution to achievement with programed instructional materials; (2) verbal creativity would contribute negatively to achievement with programed instructional materials; and (3) verbal intelligence would contribute positively to achievement with programed instructional materials, but presumably would not be as major a factor as it is under conventional modes of instruction. All possible double interactions of verbal IQ, anxiety and verbal creativity were included as additional independent variables. Control variables were prior knowledge of the learning materials taught by the program (pretest criterion) and sex of subject.

The scores of the 165 programed Ss on all independent linear variables (anxiety, IQ, pretest criterion, sex, four creativity subtests scores) and the dependent variable (posttest criterion) were converted to z scores. Nine interaction scores were calculated for each S from all the possible double interactions of the S's z scores on the anxiety measure, the creativity subtests and the IQ test. The total number of independent variables was 17.

A step-wise regression procedure was used to analyze the relative importance of the contributions of each of the 17 independent variables to sixth grader's achievement from the program used in the research. The zero order correlations of the independent linear variables with the criterion variable were as follows, in rank order of magnitude: .75 for pretest criterion, .74 for verbal IQ, -.53 for anxiety, .43 for imaginatian, .38 for fluency, .21 for originality, .21 for flexibility, and -.11 for sex. With the exception of the correlation for sex, which is nonsignficant ($p > .05$), the correlations of the other independent linear variables with the dependent variable all reach acceptable levels of significance. The correlations of the interaction scores with dependent variables scores were all low and nonsignificant.

Seventeen regression equations were obtained from the step-wise regression procedure, indicating that each of the independent variables increased the multiple correlation by a minimum of .001. The regression equation combining verbal IQ, pretest criterion, anxiety, and the interaction of originality and IQ, was selected as the most valid regression equation from among the obtained regression equations. The remaining independent variables, when combined with these variables in the regression equation, did not contribute anything unique to the prediction of achievement. The beta weights for each of the independent variables in the four-variable multiple regression equation were:

.431	pretest criterion
.436	verbal IQ
-.125	anxiety
-.106	(originality x IQ)

Verbal IQ and pretest criterion are of approximately equal importance as contributors to the prediction of achievement with programed instructional materials. The weight given for anxiety is negative and proportionately smaller, with the ratio being roughly 1.0:3.5, relative to the weights given for pretest criterion and verbal IQ. The interaction of originality and IQ functioned in the regression equation as a suppressor variable, as indicated by its negative beta weight, and its nearly zero correlation with the criterion variable.

The multiple correlation for the combined predictors, pretest criterion, anxiety, verbal IQ and the interaction of originality and IQ is .839. The value of the multiple correlation is highly significant, and the expected shrinkage as determined from the Wherry Shrinkage Formula (58) is .005.

The total criterion variance accounted for by the combined predictors in the four-variable multiple regression equation is approximately 70 percent. Approximately 32 percent of the criterion variance can be attributed to previous knowledge of the learning material (pretest criterion scores). The remaining portions of the criterion variance were accounted for by verbal IQ (approximately 32 percent), anxiety (approximately 6.6 percent), and error of prediction (approximately 30 percent). Thus, roughly 39 percent of the criterion variance is accounted for by two of the relevant independent variables. Of these, verbal IQ was shown to be the more important predictor.

The results of the analysis of the contributions of verbal IQ, verbal creativity and anxiety to achievement with the program used in the research do not support expectations. From the results of this analysis, and within the limitations of the research, the following conclusions are in order:

1. School anxiety made a small negative and significant contribution to achievement.
2. Verbal creativity, as measured by the four subtests, imagination, flexibility, originality and fluency, did not contribute significantly to achievement.
3. Verbal IQ contributed significantly and positively to achievement, and was the most important of the relevant independent variables in accounting for achievement variance.
4. Previous knowledge of the learning material in the program (pretest scores) contributed positively and significantly to achievement, and was as important in this respect as verbal IQ.
5. With the exception of the interaction of originality and IQ, the double interactions of the independent variables

verbal IQ, verbal creativity and anxiety did not contribute significantly to the prediction of achievement.

6. Sex of subject did not contribute significantly to the prediction of achievement.

Conclusions 1, 2 and 3 are discussed separately in the following sections.

Creativity

The correlational results and the results of the multiple regression analysis show that the expectation relating verbal creativity to achievement with programed instructional materials is not supported. The zero-order correlations of the creativity subtests scores with achievement scores were all positive and significant; results which are in the direction opposite to expectation. When the creativity subtests were added to the multiple regression equation at different steps -- after step four, the weights obtained for all four subtests were nonsignificant.

The results of this evaluation of the relationship of creativity to learning from programed instructional materials, should be viewed within the following limitations.

1. The subtest scores had low reliabilities. Lack of reliability was especially serious for imagination scores which had a stability coefficient of only .39.

2. The construct validity of the present battery does not yet inspire a great deal of confidence. This battery is similar in intent and construction to the verbal creativity battery developed by Torrance (55) for use with elementary school students. However, even with this battery, the construct validity of scores for elementary school students is not yet high.

3. The "novelty" of the method of instruction may have influenced the results. Prior to this research, none of the _Ss_ had experienced learning with programed instruction. Another related possibility is that the amount of time spent in instruction (approximately five hours total) was not enough to cause the creative _Ss_ to divert energy from learning.

4. Only measures of _verbal_ _creativity_ were used. Other measures of creativity may relate differently to achievement with programed instruction [e.g., tests of _nonverbal_

creativity and nonintellective measures of such characteristics as conformity, impulsiveness, anality and others, used in studies of the personality correlates of creativity (1, 2)7. Nonintellective measures of creativity may perhaps be more appropriate than intellective measures for identifying Ss who are disposed toward certain types of instruction.

In concluding this discussion of the results for creativity, it is to be noted that these results appear inconsistent with those reported by Gotkin and Massa (20), who found a significant negative correlation between fourth graders' creativity scores and their achievement with programed instructional materials.

Verbal Intelligence

Theory underlying programed instruction implies that differences in student abilities would have little or no effect on final performance as long as the student is allowed to complete the program at his own rate. The relatively large contribution of intelligence to achievement variance (32 percent) indicates that this expectation was not realized in this research. This finding, indicates that the program had a relatively low degree of effectiveness for sixth graders with different ability levels. This finding is all the more unexpected in view of the fact that precautions were taken to insure that the sample had the necessary general skills and abilities thought appropriate for successful achievement with the program. Less than seven percent of the total sample has standardized reading grade equivalent scores below 5.0; the mean IQ of the sample was 110.7; and 86 percent of the sample had IQs of 90 and above.

Achievement prior to instruction in the material taught by the program (pretest criterion) was as important a factor in final performance as IQ. With IQ and pretest achievement combined, the total contribution to achievement variance was nearly 69 percent. These findings may have important theoretical and practical implications for the construction and selection of programs for use in the school situation. First, it would seem that program developers should attend more closely to final performance as a criterion of program effectiveness during the construction of a program in addition to criteria of internal effectiveness. Gagne and Paradise (16) have made a similar recommendation. Although error rate data and other criteria of internal effectiveness were not included in this investigation, previous studies with sixth graders (8, 40), showed that the overall error rate for the Latitude and Longitude program was within the acceptable limit of ten percent. However, both this research and a previous study (40), show that sixth graders' intelligence levels contribute to achievement with the Latitude and Longitude program.

A second implication suggested by these data is that it may be necessary to construct different programs to teach the same subject matter to students with different ability levels. It seems reasonable that students with lower ability levels will need more explanation and practice than students with higher ability levels. Evidence presented by Gotkin (19) suggests that a highly structured program quite appropriate for low ability students, would be inappropriate for higher ability students. Such highly structured programs are likely to introduce other undesirable conditions which may affect the achievement of the high ability student (e.g., boredom). Of course, the use of appropriate branching techniques within any given programed instructional sequence might be the best way to accommodate individual differences in student ability.

Anxiety

In contrast with much of the previous work on anxiety and achievement (27, 44, 45, 46), this research attempted to ascertain the contribution of anxiety to achievement with controls for a relevant ability (IQ) and previous level of achievement. As a result, the contribution of anxiety to achievement was seen to be considerably smaller than would be inferred from the correlation of $\text{TASC}_{\text{adj.}}$ scores and achievement scores. This small but significant contribution, however, is inconsistent with the expectation that anxiety would contribute positively to achievement with the program used in the research.

Even though the effect of anxiety on achievement from programed instruction was negative, it may yet be that programed instruction offers as ideal a structure for the optimal learning of the school anxious child as is possible. To put it another way, although the effect of anxiety on achievement is consistently negative, the structure of the programed learning task might reduce its debilitating effects compared to other learning task structures. However, the present investigation was not designed to yield evidence on this issue.

An alternative explanation for the negative contribution of anxiety to achievement may lie in the difficulty of the criterion measure. In order to aid in discriminating among achievement levels, the criterion measure was purposely constructed to have a high difficulty level. It may be that the program did do the job of ameliorating the negative effect of anxiety on learning. However, when the more anxious students were confronted with the difficult criterion test, they may have been at a disadvantage compared with their less anxious fellows. There is evidence from studies with both children and adults (6, 27, 35, 43, 45) to indicate that the level of task difficulty is an important stressor variable which may affect the relationship between anxiety scores and performance.

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APPENDIX A

THE CRITERION TEST: FINAL FORM

"LATITUDE AND LONGITUDE"

Cornell University
School of Education
Learning Structures Project II

Write your name here: ______________________________

Your school: ______________________________

Today's date: ______________________________

Your teacher: ______________________________

INSTRUCTIONS

Say: "Good morning (afternoon). My name is _____________, and I'm from Cornell University. Today we are going to ask you some questions about Latitude and Longitude.

The questions on this test may be very difficult, and there may be many questions to which you will not know the correct answer. We do not expect that you will be able to answer all of the questions.

Read each question carefully and decide which of the answers that is provided is the one best answer. When you have decided which answer is the best, write the letter of that answer in the space that is provided at the left of the question. Try to answer every question. It is permissible for you to guess, but don't guess at a question if you really know the correct answer!

Let us look at the two sample questions on p. 1 of the test. Read sample question 1 silently, while I read it aloud. (Read it from the test.) Since the correct answer is "b" "kitten" we have written the letter "b" in the space at the left of the question. Now you do sample question number 2. Do not turn the page until you are told to do so. (pause) What is the correct choice for Sample #2? Since Ithaca is in New York, and New York is not one of the choices given, the best answer for this question is "(d) none of these". You should have written "d" in the space at the left of the question.

Are there any questions? Begin.

DIRECTIONS:

This is a test to find out how well you have learned the material in the program you have just completed about Latitude and Longitude.

Read each question carefully and decide which of the answers that is provided is the one best answer. When you have decided which answer is the best, write the letter of that answer in the space that is provided at the left of the question.

Example:

__b__ 1. A baby cat is called:

(a) a puppy
(b) a kitten
(c) both of these
(d) none of these

Since the correct answer is "(b) a kitten," we have written the letter "b" in the space at the left of the question.

Now you do this sample question. Follow the directions carefully, and then wait for instructions from your teacher. Do not begin the test until you are told to do so.

_____ 2. Ithaca is in what state?

(a) California
(b) Massachusetts
(c) Rhode Island
(d) None of these

______ 1. To be more exact in locating places, degrees can be divided into:
(a) hours and minutes
(b) hours and seconds
(c) minutes and seconds
(d) hours, minutes, and seconds

______ 2. What do we call the movement of the earth around the sun?
(a) rotation
(b) precession
(c) revolution
(d) acceleration

______ 3. A place located at 20°S latitude is about how many miles from the equator?
(a) 1200 miles
(b) 2000 miles
(c) 1400 miles
(d) 500 miles

______ 4. A circle (or parallel) drawn around the earth near the equator is _____?_____ a circle drawn near either pole.
(a) larger than
(b) as large as
(c) smaller than
(d) as small as

______ 5. The meridian passing through one of the cities was used as a prime meridian in the 1700's. Which city?
(a) Los Angeles
(b) Paris
(c) Stalingrad
(d) Tokyo

______ 6. Which answer names two cities on opposite sides of the globe?
(a) Memphis, Tennessee and Calcutta, India
(b) Madrid, Spain and Boston
(c) Oslo, Norway and Paris France
(d) San Francisco and Ithaca

______ 7. The prime meridian is numbered:
(a) 180° Longitude
(b) 90° East Latitude
(c) 0° Longitude
(d) 90° East Longitude

______ 8. When the North Pole is tipped toward the sun, the most direct sunlight falls on the Northern half of the earth. This is in what month?
(a) June
(b) February
(c) December
(d) None of these

_____ 9. Which of the following is a true statement about circles?
   (a) Big circles have more degrees than little circles.
   (b) There may be any number of degrees in a big circle.
   (c) Big circles have the same number of degrees as little circles.
   (d) Little circles have 300 degrees, but big circles have 360 degrees.

_____ 10. Can cities on opposite sides of the globe have the same latitude?
   (a) They must always have the same latitude.
   (b) They might have the same latitude.
   (c) They must never have the same latitude.
   (d) None of these.

_____ 11. A line drawn from the North Pole to the South Pole, on the surface of the globe, is called
   (a) a meridian
   (b) a latitude line
   (c) an axis
   (d) none of these

_____ 12. A point is found by locating the crossing of
   (a) the Equator and Greenwich
   (b) the Axis and Acceleration
   (c) the Meridians and Parallels
   (d) the lines of distance and the lines of latitude

_____ 13. A word meaning "first" is:
   (a) prime
   (b) grid
   (c) meridan
   (d) tertiary

_____ 14. 10° of latitude locates a point that is 10 degrees
   (a) North of the equator
   (b) South of the equator
   (c) East or West from 0 but on the equator
   (d) might be North or South of the equator.

_____ 15. The starting point for numbering longitude (zero degrees) is called:
   (a) the Greenwich Meridian
   (b) the Equator
   (c) the Prime Parallel
   (d) the Prime Axis

_____ 16. Longitude is necessary in locating a place because:
   (a) It tells how far from the Equator you are.
   (b) It checks your work in finding Latitude.
   (c) It is really a better way of measuring than Latitude.
   (d) Many different places, from East to West, could have the same location if we only used Latitude.

_____ 17. What separates latitude and longitude when writing a place's location?
(a) a dash (-)
(b) a comma (,)
(c) a semi-colon (;)
(d) a period

_____ 18. Each of the two halves into which the earth is divided by the largest parallel circle is called:
(a) a meridian
(b) a sphere
(c) a hemisphere
(d) a semisphere

_____ 19. Lines drawn in the same direction, which are the same distance apart and never meet are called:
(a) perpendicular lines
(b) meridian lines
(c) axis lines
(d) parallel lines

_____ 20. Greenwich, England is important for this reason:
(a) production of fine steel
(b) city on the Prime Meridian
(c) home of famous large sheep dogs
(d) located at 0° latitude and longitude

_____ 21. To write the longitude of a city between two meridians, you add the number of minutes to:
(a) the degree closest to the prime meridian
(b) the higher meridian that the city is near
(c) may sometimes be a or b
(d) none of these answers is correct

_____ 22. What capital letters are written after degrees of longitude?
(a) E or F
(b) N or S
(c) W or E
(d) W or N

_____ 23. Into how many degrees can a circle be divided?
(a) 60
(b) 100
(c) 69
(d) 360

_____ 24. How is the location of the prime meridian decided?
(a) Passed from country to country every 10 years
(b) By international agreement
(c) Queen Victoria bought the right to have it in England
(d) It is sold at a special auction every twenty years.

_____ 25. As you get farther away from the prime meridian, what happens to the longitude of your location?
(a) the number of degrees increases
(b) the number of degrees decreases
(c) either a or b, depending on the direction you go in
(d) none of these

_____ 26. Although degrees of longitude or latitude can be divided into both minutes and seconds, most atlases use only:
(a) degrees to locate places
(b) degrees and minutes to locate places
(c) degrees and seconds to locate places
(d) minutes and seconds to locate places

_____ 27. What do we call the movement of the earth about its own axis?
(a) rotation
(b) precession
(c) automation
(d) revolution

_____ 28. If each line of latitude on a globe or map represented one degree, how many lines would there be between the North Pole and the Equator?
(a) 360
(b) 60
(c) 69
(d) 90

_____ 29. If the location of a city is 10°5'N, 20°14'W, we know its latitude is:
(a) 20°14'
(b) 10°5'
(c) 20°14'W
(d) 10°5'N

_____ 30. What lines on a map are used to find east-west distance or location?
(a) latitude lines
(b) longitude lines
(c) both latitude and longitude lines
(d) neither latitude nor longitude lines

_____ 31. About what fraction of the earth's surface is land?
(a) 1/4
(b) 1/3
(c) 3/4
(d) 2/3

_____ 32. Another name given to the parallel circles on the globe is:
(a) meridians
(b) latitude lines
(c) longitude lines
(d) axis lines

_____ 33. One degree is what fraction of a circle?
(a) 1/7
(b) 3/4
(c) 1/100
(d) 1/360

_____ 34. If we know a place's longitude, why can't we use it to tell how many miles it is from the Greenwich Meridian?
(a) Meridians are not parallel.
(b) No one has measured the distance between 2 meridians.
(c) Meridians are farther apart as you go east.
(d) Meridians are farther apart as you go west.

_____ 35. A place located at 20°W longitude is about how many miles from the Greenwich Meridian?
(a) 1200 mi.
(b) 2000 mi.
(c) 1380 mi.
(d) can't tell.

_____ 36. Parallels on the globe are called:
(a) the earth's axis
(b) tilted lines
(c) meridians
(d) lines of latitude

_____ 37. Which of these can help us to study daylight and darkness very easily?
(a) map
(b) chart
(c) globe
(d) none of these

_____ 38. The meridian half-way around the earth from the Prime Meridian is 180°. Why?
(a) It is twice as far as from the North Pole to the South Pole.
(b) It is half a circle, or $\frac{1}{2}$ x 360.
(c) It is just accidental that it happened that way.
(d) None of these reasons is correct.

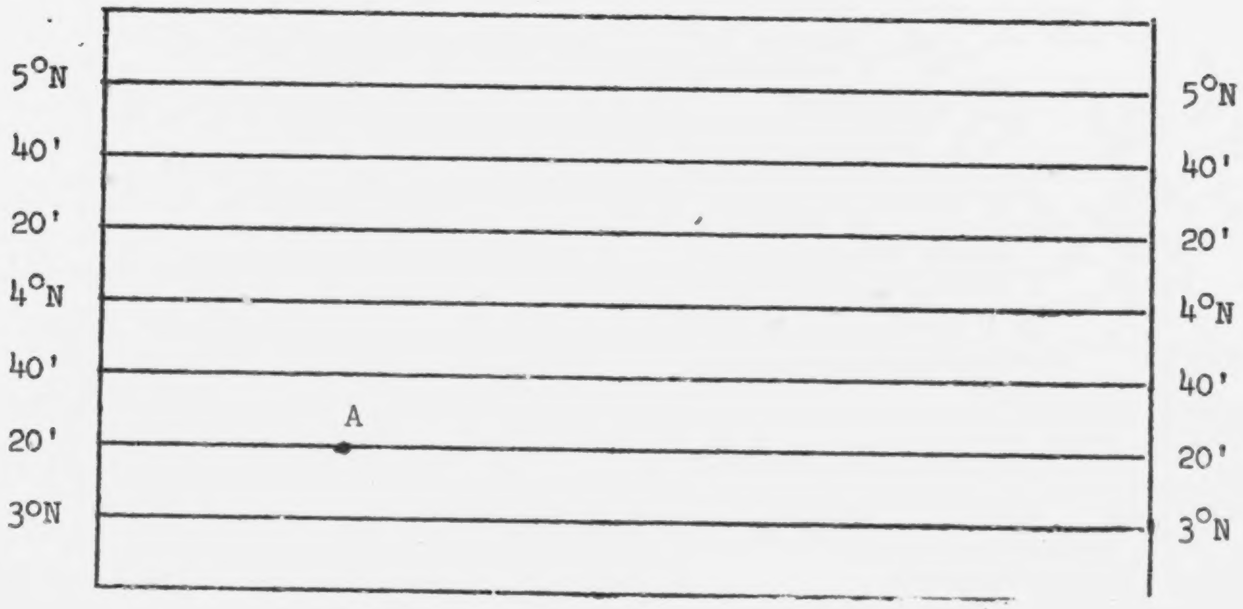
_____ 39. A city is 122°26'West of Greenwich and is 37°45'North of the equator. Its location is written as __?__ (using correct form).
(a) 122°26', 37°45'
(b) 37°45', 122°26'
(c) 122°26'W, 37°45'N
(d) 37°45'N, 122°26'W

_____ 40. 90° is equal to what fractional part of a circle:
(a) 1/2
(b) 3/4
(c) 1/3
(d) none of these

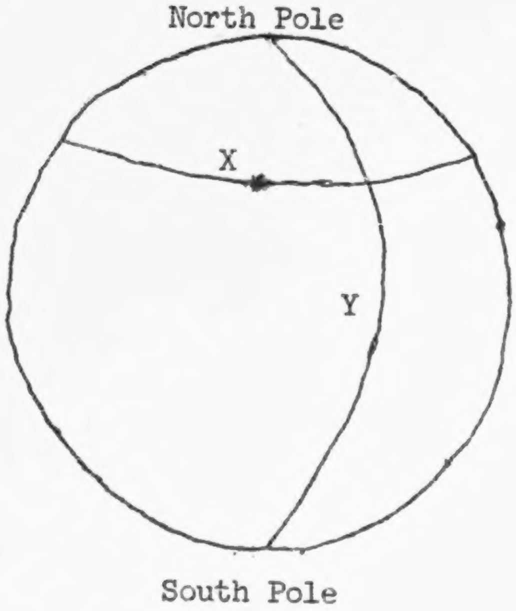
_____ 41. One degree of latitude is equal to about how many miles?
(a) 60
(b) 360
(c) 69
(d) 25

_____ 42. What lines on a globe are close together at the Poles and far apart at the equator?
(a) longitude lines
(b) latitude lines
(c) both latitude and longitude lines
(d) neither latitude nor longitude lines

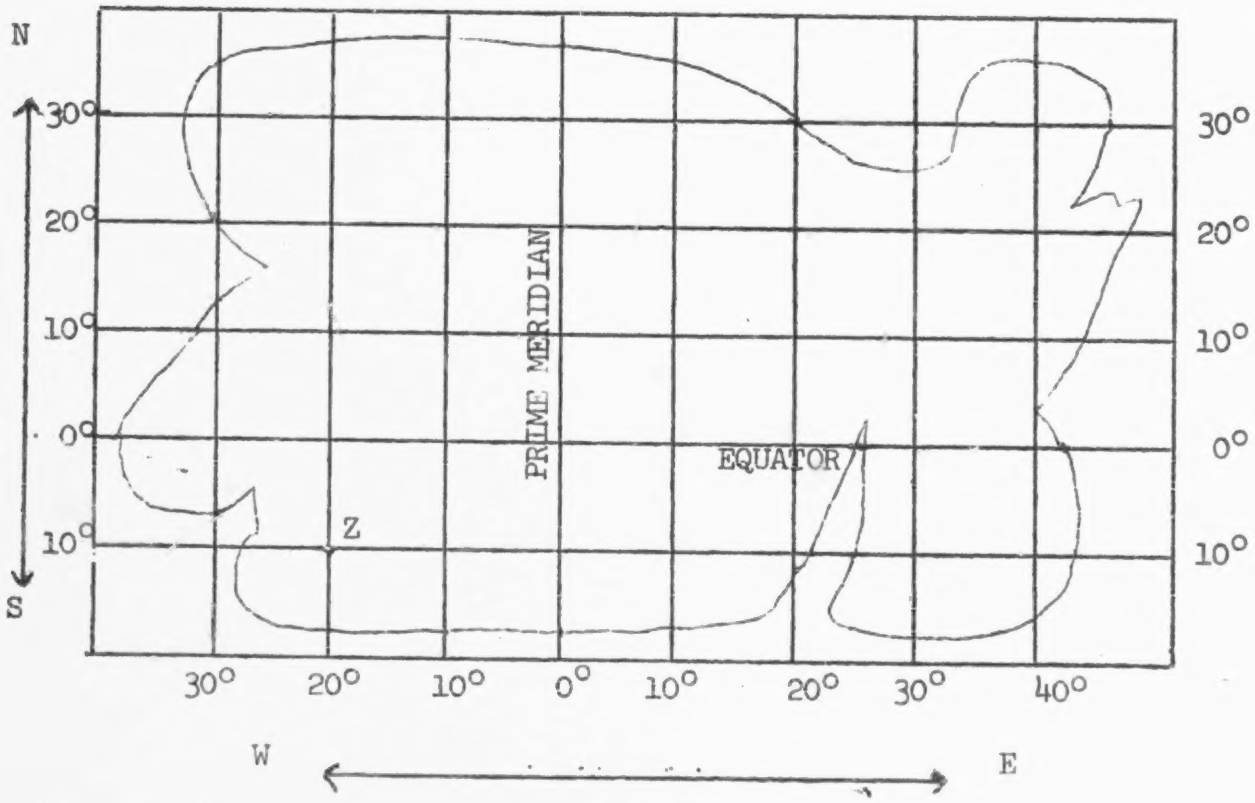
_____ 43. Tell which city is farthest away from the Prime Meridian:
(a) Oslo, Norway (10°41'E)
(b) Warsaw, Poland (21°5'E)
(c) Miami, Florida (80°12'W)
(d) can't tell from the information given



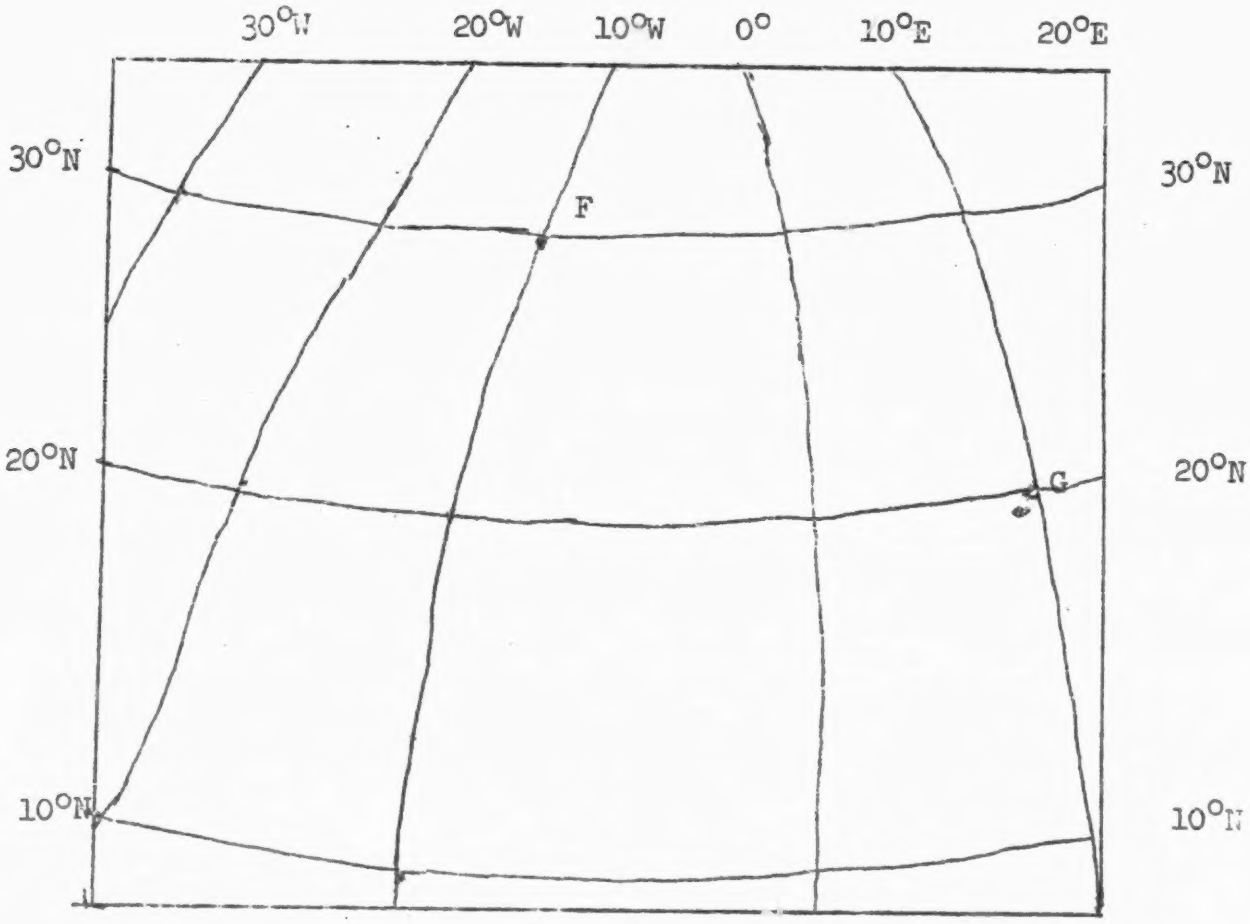
_____ 44. Point A on the map above is at:
(a) 3°40'N Longitude
(b) 4°20'N Latitude
(c) 3°20'N Latitude
(d) 3°20'N Longitude


North Pole
X
Y
South Pole

_____ 45. On the drawing above, line X is a:
- (a) meridian
- (b) parallel
- (c) equator
- (d) axis

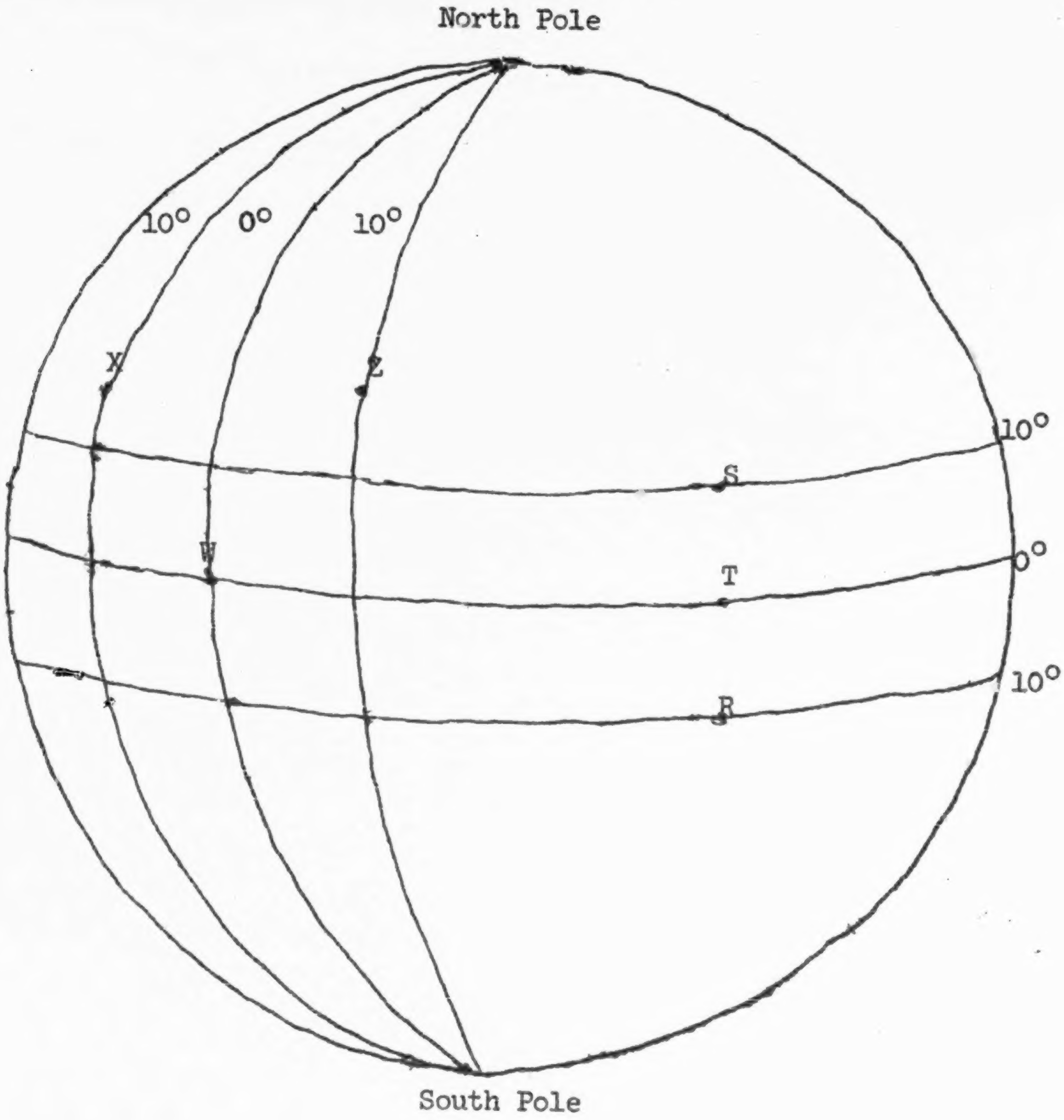

N
S
30°
20°
10°
0°
10°
30°
20°
10°
0°
10°
PRIME MERIDIAN
EQUATOR
Z
30°
20°
10°
0°
10°
20°
30°
40°
W
E

_____ 46. On the map above, the location of point Z is:
- (a) 10°E, 20°W
- (b) 10°S, 20°W
- (c) 20°E, 10°N
- (d) 20°W, 10°N


30°W
20°W
10°W
0°
10°E
20°E
30°N
30°N
F
20°N
20°N
G
10°N
10°N

_______________ 47. From the map above, write the location of Point F.

_______________ 48. From the map above, write the location of Point G.


North Pole
10°
0°
10°
X
Z
10°
S
W
T
0°
10°
R
South Pole

_____ 49. On the drawing above, the point on the prime meridian would be:
   (a) point X
   (b) point W
   (c) point T
   (d) point S

_____ 50. On the drawing above, a point on the parallel 10° north of the equator is:
   (a) point R
   (b) point X
   (c) point Z
   (d) point S

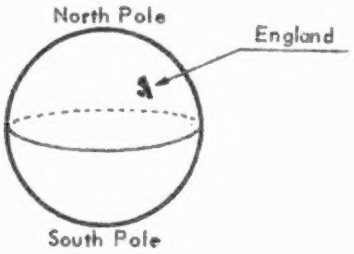
APPENDIX B

LEARNING MATERIALS

A Sample Unit from Latitude and Longitude[1]

Latitude

4-1 We have lines on the globe which help us locate places. The special parallel halfway between the poles is called the ___(?)___.	equator ●
4-2 The equator divides the globe into two hemispheres (halves). Los Angeles is in the Northern H_m_s__ere.	Hemisphere ●
4-3 The Northern Hemisphere extends from the equator to the ___(?)___ Pole.	North ●
4-4 Australia is in the Southern ____sphere.	Hemisphere ●

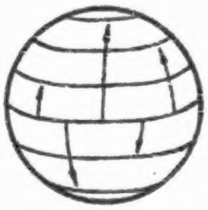


4-5 We know something about the location of England, if we know it is in the Northern ___(?)___.	Hemisphere ●
4-6 Many other countries are in the Northern Hemisphere. In order to locate England more exactly, we need to know how far north of the e___(?)___ it is.	equator

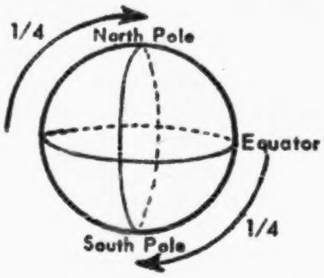
---

[1] Reprinted from Latitude and Longitude by Haring, Haring and Drum, by permission of Coronet Instruction Films, Incorporated. Copyrighted, 1962.

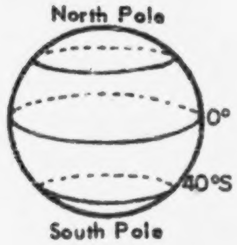
4-7 Lines drawn parallel to the equator are used to measure distance north or south of the equator. These lines are called latitude lines or p_______s.	parallels
4-8 Parallels are sometimes called latitude lines since they measure the latitude or distance north or south of the ___(?)___.	equator
4-9 Parallels can be called latitude lines since they measure l_t_tude.	latitude



4-10 Distance north or south of the equator is measured between the equator and the parallels and is called la____de.	latitude
4-11 We use degrees of latitude to measure distance north or south of the ___(?)___.	equator
4-12 Since it is the starting place for finding latitude, the equator is called zero d_gr__s (0°) latitude.	degrees
4-13 When we write 0° latitude, the symbol or sign (°) means ___(?)___.	degrees
4-14 The equator is called _(?)_ degrees l___(?)___.	0; latitude



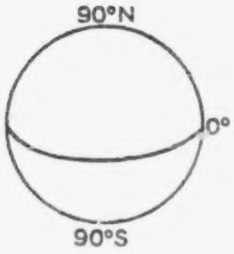
4-15 If we fly from the equator to the North Pole we fly 1/4 of a circle. If we fly from the equator to the South Pole, we also fly (?) (what fraction?) of a circle.	1/4 ●
4-16 You remember that a circle is divided into 360°. 1/4 of 360° is 90°. The equator is 0° latitude. 90°N is the North Pole and 90°S is the (?) Pole.	South ●
4-17 We number latitude lines from 0° to 90° both north and south of the (?).	equator ●
4-18 When we write the latitude of a point, we always put a capital letter N or S after the degrees to tell us whether it is north or south of the (?).	equator ●
4-19 When a latitude is in the Northern Hemisphere, we put a capital letter N after the degrees. When a latitude is in the Southern Hemisphere, we put a capital letter (?) after the degrees.	S ●
4-20 10°S tells us that the latitude is in the Southern Hemisphere. 25°N tells us that the latitude is in the (?) Hemisphere.	Northern



4-21 Forty degrees South Latitude (40°S) is in the (?) Hemisphere.

Southern

●



4-22 Latitude is measured from 0° at the (?) to 90° at the (?) s.

equator; poles

●

4-23 The equator is (?) latitude, and the North Pole is (?)N.

0° ; 90° N

●

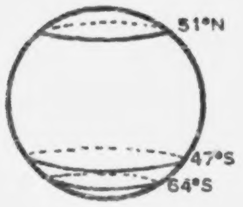
4-24 Since the equator is 0° latitude, and the North Pole is 90°N, we know that 45°N would be (?) -way between the equator and the North Pole.

halfway

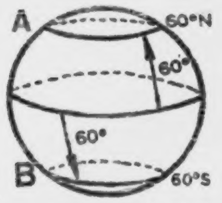
●

4-25 Paris is about forty-nine degrees North Latitude (49°N). We know that Paris is about halfway between the equator and the (?) (?) .

North Pole



4-26 In the illustration, lines 51°N, 47°S and 64°S are latitude lines. Another name for a latitude line is a p_______l.	parallel
	●
4-27 The location of a point on a parallel forty-nine degrees north of the equator is written as (?) ° (?) latitude.	49°N
	●
4-28 A parallel 49 degrees north of the equator can also be called the 49th parallel north of the equator. The 10th parallel north of the equator is is a parallel (?) degrees north of the equator.	10
	●
4-29 Moscow is located at about 56°N (fifty-six degrees North latitude). If you put your finger on Moscow and trace the 56th parallel around the globe, you will have traced a complete circle. You will now be pointing again to (?) (what city?).	Moscow
	●
4-30 A latitude line is a circle which is parallel to the equator. You cannot go from the Northern to the Southern Hemisphere and stay on the same latitude line. Any point on parallel 20°N will be in the (?) Hemisphere.	Northern
	●
4-31 Latitude is the distance north or south of the (?).	equator
	●
4-32 The distance between 0° and 10°N is 10 degrees. The distance between 0° and 10°S is (?) (?).	10 degrees



4-33 Parallel A and parallel B are the same distance from the equator. Parallel A is 60°N. Parallel B is (?)$^{(?)}$(?) .

60°S

●

4-34 A degree of latitude is about 69 miles.
1°N is 69 miles north of the equator.
10°N is 10 x 69 miles north of the equator.
20°N is 20 x (?) miles north of the equator.

69

●

4-35 The latitude of New Orleans is 30°N. To find how many miles north of the equator New Orleans is, we multiply 30° x (?) .

69

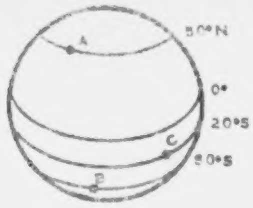
●

Review

4-36 One degree of latitude equals (?) miles.

69

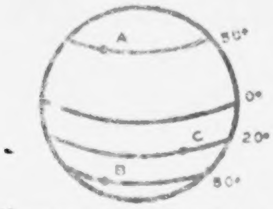
●



4-37 From the illustration, write the latitude of points A, B and C.
A = (?)
B = (?)
C = (?)

A = 50°N;
B = 50°S;
C = 20°S

●



4-38 On the illustration, Point A is (?) degrees (?) of the equator.

50; north

End of Set 4

●

A SAMPLE STUDENT RESPONSE SHEET FOR
LATITUDE AND LONGITUDE

Name____________________ Teacher____________________

Set One

1) __________

2) s _ h e r e

3) s _ _ e r e

4) __________

5) __________

6) __________

7) __________

8) __________

9) _ p _ _ _ _

10) __________

11) g__________

12) s _ _ e r _ c a l

13) __________rical

14) __________

15) __________

16) __________

17) __________

18) _ _ _ _

19) __________

20) in__________

21) __________

22) __________

23) __________

24) __________(what fraction?)

25) __________

26) __________

27) __________

28) g__________

29) __________

30) l _ _ _ _ _ _ _ _

31) __________

32) __________

33) __________

34a) __________

b) __________

35) __________

36) __________

37) __________

37b) __________

TEACHER INSTRUCTIONS FOR USING "LATITUDE AND LONGITUDE"

As we prepare to begin our research project, we thought you might find it helpful if we were to list some ideas about "getting your class off on the right foot" with programed instruction.

1) Have some of the children in your class assemble the sliding answer covers of the programs, before the time comes for the entire class to begin work.

2) Before the programed instruction begins, take a few minutes to look at the program with the whole class. Explain briefly how it is to be used. Have a student read aloud the foreword in the program. The idea of working through half the program, then turning it over and working back again may be confusing; plan on some time for an explanation before they begin to work.

3) Stress that the answer in the program should not be uncovered until the student's answer has been written on his answer sheet, and that the child should not change his answer after checking it.

4) On the first day of programed instruction, tell the class that they are participating in an experiment for Cornell University.

5) Discuss the fact that the programed unit constitutes a regular part of the children's school work, and that they will receive a mark. (We will report the criterion test scores to you within two weeks of the completion of the program, and the personality test scores shortly thereafter.)

6) There should not be any writing on the program itself. Please circulate around the class, especially during the first few days, to check on this (and to check on Item 3, above.)

7) Encourage the children to use a 3-step procedure: "Think the answer; write it on the answer sheet; check it from the program."

8) Encourage the children not to skip any of the small steps (called "frames") in the program.

9) We have left space on the answer sheets for those frames which ask the student to make a drawing. Encourage neatness, but assure them that there is no need for works of art.

10) The double-columned answer sheets may require a brief explanation. The numbers of the blanks follow the frame numbers in each lesson. They contain any "cues" provided in the program. In some cases where a frame has two blanks that are spread apart, the distinction 'a' and 'b' appears on the answer sheets. The groups of blanks on each answer sheet correspond to pages, each in the same order as in the lesson.

11) Collect the programs and the answer sheets daily. Envelopes are provided to store the answer sheets by lesson.

12) Do not allow any student to re-do a set in the program. (We use the words "set" and "lesson" interchangeably.)

13) Do not allow any student to do more than one set in a day. An exception to this can be made only for the student who needs to "make up" a set he missed because of absence.

14) In general, we feel it is best if you will not give aid to the students, except to direct them to re-read a certain frame with extra care. Usually, the student should be able to give the correct response if he has been careful in reading the frame.

15) The program should require 15-30 minutes per day for each pupil. Watch, especially during the first few days, to see that no student "races" thoughtlessly, and to see that no student is "poking"- that is, working slower than he usually is able to do.

16) If a student does make an error, and wishes to correct it--before sliding down the answer cover -- he should make his correction by crossing out the incorrect response and putting in his corrected choice. Give directions to the effect that there should not be any erasing on the answer sheet. Of course, as we mentioned, the child should not change his answer after checking it, but he can write the correct answer next to his for the practice.

(Summary: To change before checking: cross out and write again. Do not cross out an answer after checking it, but if it is incorrect, write the correct answer next to it. Never erase.)

APPENDIX C

Instructions Used in Administering the Test Anxiety Scale for Children and the Lie Scale for Children[1]

My name is ________________. I'm going to be asking you some questions--questions different from the usual school questions for these are about how you feel and so have no right or wrong answers. First I'll hand out the answer sheets and then I'll tell you more about the questions...

Write your name at the top of the first page, both your first and your last names...Also write a B if you're a boy or a G if you're a girl. (For the fourth, fifth, and sixth grades, "Write the name of the school you attended last year and year before last year.")

As I said before, I am going to ask you some questions. No one but myself will see your answers to these questions, not your teacher or your principal or your parents. These questions are different from other questions that you are asked in school. These questions are different because there are no right or wrong answers. You are to listen to each question and then put a circle around either "yes" or "no." These questions are about how you think and feel and therefore, they have no right or wrong answers. People think and feel differently. The person sitting next to you might put a circle around "yes" and you may put a circle around "no." For example, if I asked you this question: "Do you like to play ball?" Some of you would put a circle around "yes" and some of you would put it around "no." Your answer depends on how you think and feel. If you don't understand a question, ask me about it.

Now let's start by everybody putting their finger on Number 1. Here is the first question. Number 1. "Do you worry when __________?" (Repeat this procedure of introducing the questions for several of them and continue throughout to say the number of the question before reading it.)

In the following questions the word "test" is used. What I mean by "test" is any time the teacher asks you to do something to find out how much you know or how much you have learned. It could be by your writing on paper, or by your speaking aloud, or by your writing on the blackboard. Do you understand what I mean by "test"--it is any time the teacher asks you to do something to find out how much you know.

---

[1] Adapted from S. B. Sarason et al., (1960, pp. 306-309).

APPENDIX D

TEACHER RANKING OF PUPIL ANXIETY
(INSTRUCTIONS)

1. During the past week, you have been comparing the behaviors of your pupils with the behavioral criteria related to our definition of pupil anxiety. This ranking device will ask you to rank each of your pupils according to his position in the class in terms of similarity to the definition of pupil anxiety.

2. Each card in the enclosed group should contain the name of your pupils. If there are changes needed, because of changes in the enrollment of your class, that we did not know about when making up these cards, please make the corrections.

3. Rank all of the pupils in your class, including any who may be absent today, or who were absent when our testing was done.

4. Begin by dividing the cards into two groups on your desk. In the group at your left, place the cards of pupils who are like the definition of anxiety. At your right, place the cards of those who are unlike the definition. (See Figure 1.)

5. Then, divide each group again. Now, the group at the extreme left represents those most like the definition. Moving from left to right, the other three groups represent: moderately like the definition; moderately unlike the definition; and, most unlike the definition. (See Figure 2.)

6. Then spread out the cards in each group vertically, so that the cards of the pupils most like the definition of any in that group are at the top of the pile. (See Figure 3.)

7. Assign numbers to each student's card (writing the appropriate number lightly on the front of each card, after the pupil's name). The cards should be numbered consecutively, beginning at the top of the column at the extreme left, and working down from the top of each subsequent column. (See Figure 4.)

8. The result should be a rank ordering of your rating of the comparison of your pupils to the definition of anxiety. The last number should be equal to the total number of pupils in your class. A ranking of "1" indicates that the pupil is rated as being very much like the definition of anxiety; a rank of "20" or "21) (as examples) will identify a pupil rather unlike the definition.

9. Return the completed deck of cards to us in the enclosed envelope.

FIGURE ONE

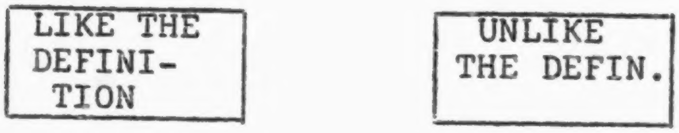

LIKE THE DEFINITION
UNLIKE THE DEFIN.

FIGURE TWO

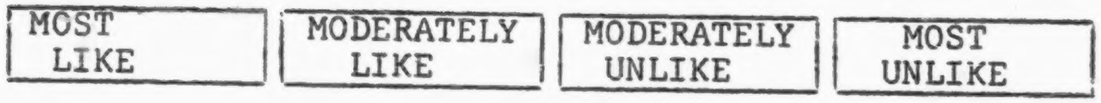

MOST LIKE
MODERATELY LIKE
MODERATELY UNLIKE
MOST UNLIKE

FIGURE THREE

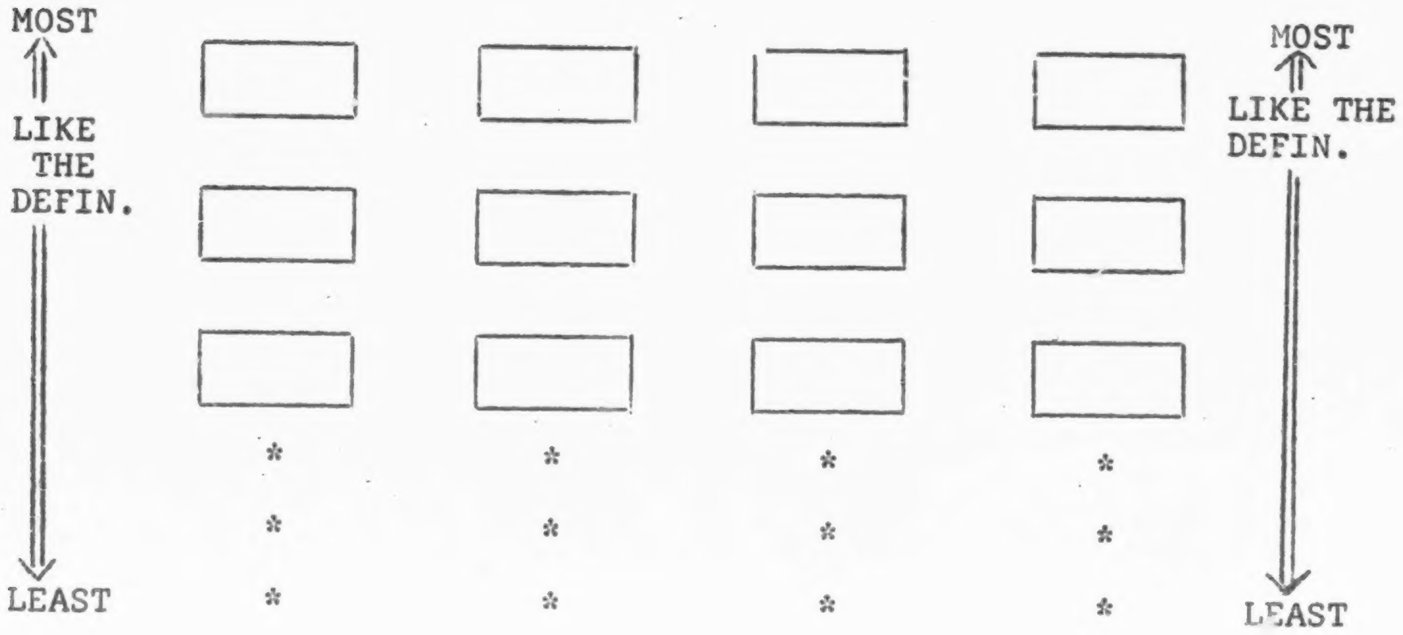
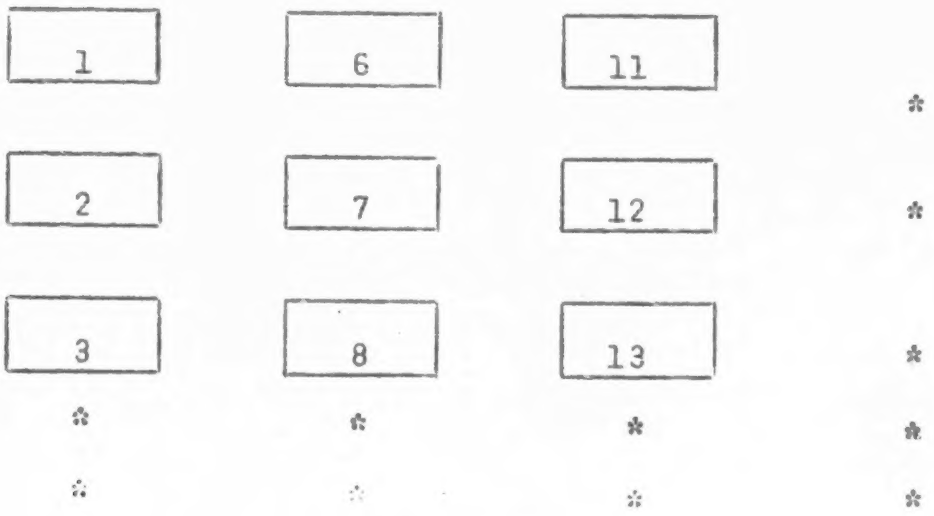

MOST
LIKE THE DEFIN.
LEAST
MOST
LIKE THE DEFIN.
LEAST

FIGURE FOUR


1
6
11
2
7
12
3
8
13

ANXIETY DEFINITION

On the left are listed several classroom situations which may conceivably elicit anxiety.

On the right are student behaviors which may occur as reactions to these situations.

A. CLASSROOM SITUATIONS	B. OBSERVED BEHAVIORS INDICATING ANXIETY
1) TESTS a) before, during and shortly after taking teacher-made examinations, standardized tests (e.g., achievement exams)	1. Fidgeting, squirming, nail biting, head scratching. 2. Complaints about frequency of testing. 3. Often absent on test days but normally present for regular sessions. 4. Expresses desire to use bathroom before or after test.
2) RECITATION a) writing on blackboard b) oral reports c) answering teacher-directed questions d) particularly questions directed at ascertaining student's knowledge of assignment or something student is expected to know.	1. Stammering, stuttering, speed-up in verbalizations; verbalizations become progressively disorganized; may become unable to answer (onset of emotion). 2. Trembling, increased perspiration. Evidence of confusion (progressive). Desires not to compete in audience situations.
3) DISCIPLINE a) disciplinary actions by teacher for incomplete assignments, careless work, irresponsible behavior b) actions by teacher not intended as disciplinary but perceived by student as such (e.g., telling student he has made a mistake)	1. Student's orientation is very defensive--attempts to give an explanation for any shortcomings whether real or not. 2. Becomes emotionally affected by teacher's comments; more disoriented by teacher comments than would be normally expected.

ANXIETY DEFINITION (Cont'd)

A. CLASSROOM SITUATIONS	B. OBSERVED BEHAVIORS INDICATING ANXIETY
4) INTERPERSONAL RELATIONS WITH PEERS a) during group discussions, project work, etc. b) reactions to public comments made in class by other students c) other classroom situations involving student-student interactions.	1. Quick to anger, cry or in other ways show sensitivity to students' comments. 2. Perceives derogations or criticisms in situations which are easily judged as noncritical or nonthreatening. 3. Expresses concern over relations with peers.
5) EVALUATION a) receipt of test marks b) receipt of report card c) other activities in which the student's academic performance is formally evaluated	1. Shows frequent concern over school progress; cries or in other ways shows emotionality over report card marks, etc. 2. Expresses concern over parental reactions to school grades.
6) SEATWORK a) assignments completed in class b) assignments with a time limit completed in class	1. Unable to keep at school tasks consistently; spends much classroom time looking around the room, fidgeting, and in other ways escaping from the task.

APPENDIX E

THE STUDENT ABILITIES SURVEY

(Dacey-Ripple Verbal Creativity Battery)

NAME____________________

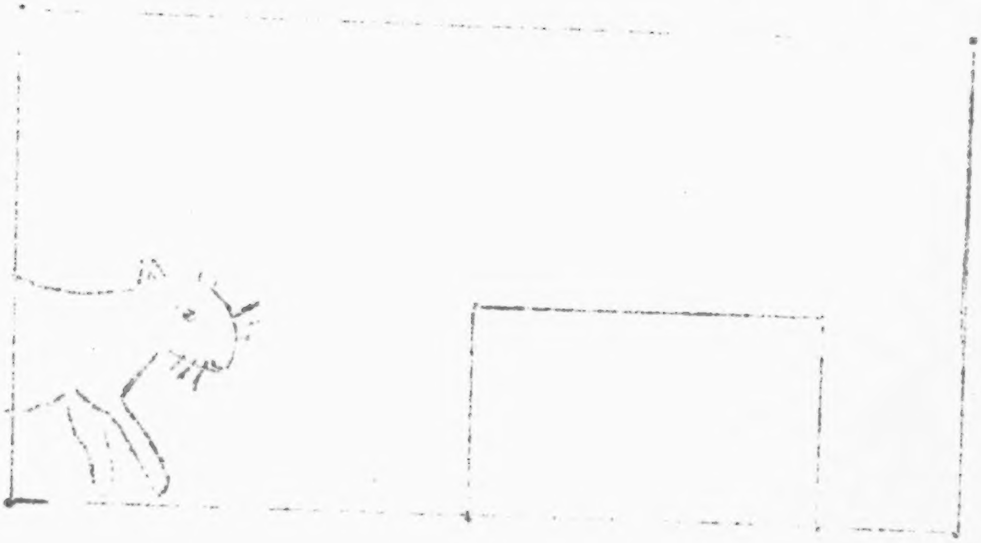
This is a survey to find out how well sixth grade students are able to perform certain tasks. Simply do each task as quickly as possible. Sign your name on this page and all others which have a line for it.

When I tell you to stop working and go to the next page, please do so immediately. Now, when I tell you, turn the page and begin answering.

Not to be used without permission of the authors. Permission for use of this survey for research purposes will be granted upon request.

1. IMAGINATION

You are to look at this picture and make up a story about it. The more words you use, the better. Try to make it a story no one else in the class would think of. Be as different from the others as you can. Try to give your story an imaginative title. Write your story on the next page. You have eight minutes working time. Begin.



1. IMAGINATION Name ____________________

(OVER)

1. IMAGINATION (continued)

STOP HERE AND WAIT FOR FURTHER INSTRUCTIONS

2. ASKING QUESTIONS

Name ____________________

On this page, write out all of the questions you can think of about the drawing on the page opposite this one. Ask all of the questions you need to know for sure what is happening. Do not ask questions which can be answered just by looking at the drawing. You can continue to look back at the drawing as much as you want to. You have five minutes working time. Begin.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________
19. ____________________
20. ____________________

STOP HERE AND WAIT FOR FURTHER INSTRUCTIONS.

EZK

3. GUESSING CAUSES Name ____________________

In the spaces below, list as many possible causes as you can of the action shown in the picture. You may use things that might have happened just before the event in the picture, or something that happened a long time ago that made the event happen. Make as many guesses as you can. Don't be afraid to guess. You have five minutes working time. Begin.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________
19. ____________________
20. ____________________

STOP HERE AND WAIT FOR FURTHER INSTRUCTIONS.

E.Z.K

4. GUESSING CONSEQUENCES: Name ____________________

In the spaces below, list as many possibilities as you can of what might happen as a result of what is taking place in the picture. You may use things that might happen right afterward or things that might happen as a result long afterward in the future. Make as many guesses as you can. Don't be afraid to guess. You have five minutes working time. Begin.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________
19. ____________________
20. ____________________

STOP HERE AND WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX F

DISCRIMINATION INDEXES (PER CENTS) AND LEVEL OF DIFFICULTY INDEXES (PER CENTS) FOR ITEMS IN THE FINAL CRITERION MEASURE

(N = 206)

Item	Level of Difficulty*	Discrimination Index**	Item	Difficulty[1]	Discrim.
1	57	29	26	47	41
2	62	53	27	73	46
3	22	12	28	43	42
4	75	38	9	57	52
5	35	32	30	54	70
6	45	74	31	60	40
7	69	52	32	45	78
8	51	21	33	71	68
9	57	46	34	53	56
10	56	36	35	51	-09
11	59	72	36	67	63
12	61	64	37	65	51
13	65	69	38	53	56
14	74	48	39	29	45
15	52	77	40	48	40
16	51	60	41	51	62
17	60	70	42	43	49
18	47	46	43	67	48
19	78	31	44	61	47
20	76	50	45	79	42
21	49	43	46	78	25
22	58	68	47	48	83
23	74	40	48	44	76
24	67	59	49	56	44
25	56	53	50	57	44

*Level of Difficulty = Per Cent of total students responding correctly. (Low per cent = difficult item.)

**Discrimination = difference between the per cent answering correctly in the upper 27% of students and the per cent answering correctly in the lower 27% of students (based on total score).

---

[1] These figures are based on the post test administration of the final criterion test during the experimental phase of the research.

APPENDIX G

USING INTERACTION TERMS IN MULTIPLE REGRESSION EQUATIONS[1]

Frequently multiple regression is used as an alternative to analysis of variance. Consider the standard form:

$$Y = b_1x_1 + b_2x_2 + b_3x_1x_2 + c$$

If b_1 and/or b_2 show significance at the required level, then there is said to be a significant "main" effect. If b_3 shows significance at the required level, then there is said to be a significant "interaction" effect.

NOTE: IF THERE IS A NONZERO INTERACTION EFFECT, THEN (UNLESS ALL VARIABLES ARE STANDARDIZED TO X=0.0) b_1 and b_2 are (in part) A FUNCTION OF THE MEAN OF x_1 and THE MEAN OF x_2.

In other words, by transforming (linear!) x_1 and x_2 any size beta weight for x_1 and x_2 can be obtained, and the correlation between the interaction term and the linear variables can be fixed at will.

ILLUSTRATION:

Suppose that we start with

$$\hat{Y}=b_1(x_1-\bar{X}_1) + b_2 (x_2-\bar{X}_2) + b_3(x_1-\bar{X}_1) (x_2-\bar{X}_2) \text{ then we have}$$

$$\hat{Y} = b_1x_1 - b_1\bar{X}_1 + b_2x_2 - b_2\bar{X}_2 + b_3x_1x_2 + b_1X_2 - b_3x_2\bar{X}_1x_1 + b_3\bar{X}_1\bar{X}_2$$

since $b_1\bar{X}_2$, $b_2\bar{X}_2$ and $b_3\bar{X}_1\bar{X}_2$ are constants, we have

$$\hat{Y} = b_1x_1 + b_2x_2 + b_3x_1x_2 + b_3x_1\bar{X}_2 + b_3x_2\bar{X}_1 + c$$

The beta weight received by x_1 is therefore equal to:

$$b_{received} = (b_{true} -b_3X_2)$$

The only case in which

$$b_{received} = b_{true}$$

---

[1] This proof was written by Dieter Paulus (1966) of the University of Connecticut at the request of the authors.

is when either $b_3 = 0.0$ and/or $\overline{X}_2 = 0.0$. If there is a significant interaction effect, then $b \neq 0.0$ and we must standardize all scores to $X_1 = X_2 = 0.0$ if we want

$$b_{received} = b_{true}$$

If triple interaction terms are used, then the beta weights assigned to the two-way interaction are affected in the same way as the beta weights of the linear terms were affected above.

Note also, that if $b_{received}$, b_3 and the means are known, then the true beta weights may be calculated.

APPENDIX H

SUMMARY OF THE RESULTS OF THE STEP-WISE REGRESSION PROCEDURE

The results for all 17 steps of the step-wise regression analysis, reproduced directly from the computer printout, are shown in Table XXIX below. "Printout" for each step is in the form as shown in Table XXIX.

TABLE XXIX

Sample Output From The Step-wise Multiple Regression Procedure

```
STEP NO.                   1

ENTERED VARIABLE           9

F-LEVEL                       209.41313
STD ERROR EST Y                  .66364
MULTIPLE CORRELATION             .74988
R-SQUARED                        .56231
DEGREES OF FREEDOM                  163
CONSTANT TERM                   -.00110

  VARIABLE    BETA PRIME*        BETA          SE(BETA)
     9        7.49876E-01    7.50077E-01    5.18327E-02
```

---

*The symbol E-01 gives the number of places and the direction the decimal point is to be moved (E- indicates to the left, E indicates to the right).

As shown in Table XXIX, the <u>step number</u> (in the present study) indicates the number of independent variables which appear in the regression equation for each step. <u>Entered Variable</u>, identifies the variable number of the independent variable added to the regression equation at a particular step. The standard error of estimating <u>Y</u> (STD ERROR EST Y), is the estimated residual standard error and is calculated from the formula:

$$\sqrt{\frac{\Sigma(\hat{Y}-Y)}{N-n-1}}$$

where $\Sigma(\hat{Y} - Y)^2$ is the sum of the squared residuals, and n is the number of predictor variables in the multiple regression equation. The remaining elements of the regression equations for each step are clearly labeled and need no further explanation.

The procedures used in obtaining the step-wise regression results are outlined briefly below:

(1.) The computations for the step-wise regression analysis were performed using the University's Control Data 1604 Computer and a multiple regression program (REFAC) provided by the University's Computing Center.

(2.) Input data consisted of raw scores.

(3.) All independent linear variables (variables 2 through 9) and the dependent variable (variable 1) were then converted to z scores (zero mean, unit variance) using standard computer transformation procedures.

(4.) The interaction scores (variables 10-18) were calculated using standard computer transformation procedures (e.g., the interaction of variables 4 and 5 = $z_4 \times z_5$).

(5.) There were no missing observations.

(6.) The regressions were then calculated using the Ss' scores on all independent, dependent and control variables (i.e., the linear variables plus the interaction terms).

(7.) The computer programing was done by project staff with assistance from Dieter Paulus and Donald Burrill, a member of the Univeristy's Computing Center staff.

All variables used in the regression equation (Table XXIX) may be identified by matching the variable number given in the step-wise regression results with the variable names and numbers shown in Table XXX.

TABLE XXX

Identification of Names and Numbers of the Variables Used In the Step-wise Regression Analysis

TYPE OF VARIABLE	VARIABLE NUMBER	VARIABLE NAME
Dependent	1	Post Test Criterion
Control	2	Sex
Independent	3	Lorge-Thorndike Verbal IQ
Independent	4	Imagination Subtest
Independent	5	Flexibility Subtest
Independent	6	Originality Subtest
Independent	7	Fluency Subtest
Independent	8	$\text{TASC}_{\text{adj.}}$
Control	9	Pretest Criterion
Independent	10	(Imagination x $\text{TASC}_{\text{adj.}}$)
Independent	11	(Flexibility x $\text{TASC}_{\text{adj.}}$)
Independent	12	(Originality x $\text{TASC}_{\text{adj.}}$)
Independent	13	(Fluency x $\text{TASC}_{\text{adj.}}$)
Independent	14	(IQ x $\text{TASC}_{\text{adj.}}$)
Independent	15	(Imagination x IQ)
Independent	16	(Flexibility x IQ)
Independent	17	(Originality x IQ)
Independent	18	(Fluency x IQ)

```
STEP NO.            1

ENTERED VARIABLE    9

  F-LEVEL                       209.41313
  STD ERROR OF EST Y               .66364
  MULTIPLE CORRELATION             .74988
  R-SQUARED                        .56231
  DEGREES OF FREEDOM                  163
  CONSTANT TERM                   -.00110

    VARIABLE     BETA PRIME       BETA              SE(BETA)
         9      7.49876E-01   7.50077E-01     5.18327E-02


STEP NO.            2

ENTERED VARIABLE    3

  F-LEVEL                        62.93740
  STD ERROR OF EST Y               .56493
  MULTIPLE CORRELATION             .82751
  R-SQUARED                        .68478
  DEGREES OF FREEDOM                  162
  CONSTANT TERM                   -.00219

    VARIABLE     BETA PRIME       BETA              SE(BETA)
         9      4.65686E-01   4.65811E-01     5.68400E-02
         3      4.50808E-01   4.50777E-01     5.68208E-02


STEP NO.            3

ENTERED VARIABLE    8

  F-LEVEL                         4.53939
  STD ERROR OF EST Y               .55886
  MULTIPLE CORRELATION             .83272
  R-SQUARED                        .69342
  DEGREES OF FREEDOM                  161
  CONSTANT TERM                   -.00220

    VARIABLE     BETA PRIME       BETA              SE(BETA)
         9      4.23878E-01   4.23992E-01     5.95564E-02
         8     -1.10866E-01  -1.10920E-01     5.20611E-02
         3      4.26233E-01   4.26204E-01     5.73812E-02
```

```
STEP NO.           4

ENTERED VARIABLE  17

  F-LEVEL                          5.64820
  STD ERROR OF EST Y                .55096
  MULTIPLE CORRELATION              .83897
  R-SQUARED                         .70388
  DEGREES OF FREEDOM                   160
  CONSTANT TERM                     .02356

    VARIABLE     BETA PRIME         BETA            SE(BETA)
       17       -1.05537E-01    -7.85645E-02     3.30576E-02
        9        4.31404E-01     4.31519E-01     5.88003E-02
        8       -1.25154E-01    -1.25216E-01     5.16767E-02
        3        4.35913E-01     4.35883E-01     5.67158E-02


STEP NO.           5

ENTERED VARIABLE   7

  F-LEVEL                          3.43676
  STD ERROR OF EST Y                .54682
  MULTIPLE CORRELATION              .84270
  R-SQUARED                         .71014
  DEGREES OF FREEDOM                   159
  CONSTANT TERM                     .02660

    VARIABLE     BETA PRIME         BETA            SE(BETA)
       17       -1.17959E-01    -8.78113E-02     3.31857E-02
        9        4.19403E-01     4.19515E-01     5.87157E-02
        8       -1.23465E-01    -1.23526E-01     5.12957E-02
        7        8.69465E-02     8.70555E-02     4.69593E-02
        3        4.14774E-01     4.14745E-01     5.74330E-02


STEP NO.           6

ENTERED VARIABLE   5

  F-LEVEL                          1.23427
  STD ERROR OF EST Y                .54641
  MULTIPLE CORRELATION              .84403
  R-SQUARED                         .71239
  DEGREES OF FREEDOM                   158
  CONSTANT TERM                     .02773

    VARIABLE     BETA PRIME         BETA            SE(BETA)
       17       -1.22479E-01    -9.11765E-02     3.32993E-02
        9        4.14813E-01     4.14924E-01     5.88179E-02
        8       -1.26214E-01    -1.26276E-01     5.13177E-02
        7        7.74404E-02     7.75375E-02     4.77004E-02
        5        4.95452E-02     4.95969E-02     4.46426E-02
        3        4.11900E-01     4.11872E-01     5.74490E-02
```

```
STEP NO.            7

ENTERED VARIABLE   6

  F-LEVEL                          .86515
  STD ERROR OF EST Y               .54665
  MULTIPLE CORRELATION             .84496
  R-SQUARED                        .71396
  DEGREES OF FREEDOM                  157
  CONSTANT TERM                    .01996

    VARIABLE     BETA PRIME         BETA           SE(BETA)
       17      -9.05757E-02   -6.74267E-02   4.19733E-02
        9       4.12352E-01    4.12462E-01   5.89025E-02
        8      -1.27350E-01   -1.27413E-01   5.13541E-02
        7       8.90171E-02    8.91287E-02   4.93211E-02
        6      -5.72036E-02   -5.72633E-02   6.15647E-02
        5       5.69777E-02    5.70371E-02   4.53723E-02
        3       4.19892E-01    4.19863E-01   5.81122E-02


STEP NO.            8

ENTERED VARIABLE  15

  F-LEVEL                          .98217
  STD ERROR OF EST Y               .54668
  MULTIPLE CORRELATION             .84602
  R-SQUARED                        .71575
  DEGREES OF FREEDOM                  156
  CONSTANT TERM                    .03236

    VARIABLE     BETA PRIME         BETA           SE(BETA)
       17      -6.07608E-02   -4.52318E-02   4.75765E-02
       15      -5.08613E-02   -4.51029E-02   4.55105E-02
        9       4.12825E-01    4.12936E-01   5.89077E-02
        8      -1.32522E-01   -1.32588E-01   5.16218E-02
        7       8.89255E-02    8.90370E-02   4.93240E-02
        6      -6.28739E-02   -6.29395E-02   6.18340E-02
        5       5.82760E-02    5.83368E-02   4.53938E-02
        3       4.19841E-01    4.19813E-01   5.81155E-02

STEP NO.            9

ENTERED VARIABLE  11

  F-LEVEL                         1.10541
  STD ERROR OF EST Y               .54649
  MULTIPLE CORRELATION             .84721
  R-SQUARED                        .71777
  DEGREES OF FREEDOM                  155
  CONSTANT TERM                    .03611

    VARIABLE     BETA PRIME         BETA           SE(BETA)
       17      -6.86439E-02   -5.11002E-02   4.78868E-02
       15      -6.50322E-02   -5.76694E-02   4.70390E-02
       11      -4.95983E-02   -4.44642E-02   4.22910E-02
        9       4.16615E-01    4.16727E-01   5.89982E-02
```

```
          8     -1.38015E-01   -1.38084E-01    5.18685E-02
          7      8.60105E-02    8.61184E-02    4.93854E-02
          6     -6.55617E-02   -6.56302E-02    6.18661E-02
          5      6.14637E-02    6.15278E-02    4.54799E-02
          3      4.15400E-01    4.15371E-01    5.82493E-02
 STEP NO.           10

 ENTERED VARIABLE  16

   F-LEVEL                        .80914
   STD ERROR OF EST Y             .54672
   MULTIPLE CORRELATION           .84815
   R-SQUARED                      .71935
   DEGREES OF FREEDOM              154
   CONSTANT TERM                  .03516

     VARIABLE    BETA PRIME       BETA             SE(BETA)
        17      -6.47959E-02   -4.82357E-02    4.80055E-02
        16      -5.23702E-02   -4.84427E-02    5.19618E-02
        15      -4.66124E-02   -4.13351E-02    5.02147E-02
        11      -7.03645E-02   -6.30808E-02    4.67846E-02
         9       4.22242E-01    4.22355E-01    5.93310E-02
         8      -1.38401E-01   -1.38469E-01    5.18920E-02
         7       8.30651E-02    8.31692E-02    4.95074E-02
         6      -6.83797E-02   -6.84511E-02    6.19661E-02
         5       6.53474E-02    6.54156E-02    4.56898E-02
         3       4.10616E-01    4.10588E-01    5.84993E-02


 STEP NO.           11

 ENTERED VARIABLE   4

   F-LEVEL                        .53451
   STD ERROR OF EST Y             .54755
   MULTIPLE CORRELATION           .84872
   R-SQUARED                      .72033
   DEGREES OF FREEDOM              153
   CONSTANT TERM                  .03590

     VARIABLE    BETA PRIME       BETA             SE(BETA)
        17      -6.36762E-02   -4.74021E-02    4.80917E-02
        16      -5.02711E-02   -4.65010E-02    5.21083E-02
        15      -4.97151E-02   -4.40864E-02    5.04314E-02
        11      -6.80228E-02   -6.09814E-02    4.69434E-02
         9       4.11831E-01    4.11941E-01    6.11042E-02
         8      -1.40765E-01   -1.40834E-01    5.20712E-02
         7       7.89746E-02    7.90737E-02    4.98979E-02
         6      -7.53804E-02   -7.54591E-02    6.27959E-02
         5       5.94419E-02    5.95039E-02    4.64680E-02
         4       3.85888E-02    3.86130E-02    5.28148E-02
         3       4.04312E-01    4.04284E-01    5.92189E-02
```

```
STEP NO.          12

ENTERED VARIABLE  18

   F-LEVEL                        .55438
   STD ERROR OF EST Y             .54835
   MULTIPLE CORRELATION           .84932
   R-SQUARED                      .72134
   DEGREES OF FREEDOM                152
   CONSTANT TERM                  .02913

      VARIABLE     BETA PRIME        BETA           SE(BETA)
         18      4.01848E-02    3.98429E-02     5.35115E-02
         17     -8.09593E-02   -6.02681E-02     5.11679E-02
         16     -5.32963E-02   -4.92993E-02     5.23195E-02
         15     -5.70019E-02   -5.09483E-02     5.12452E-02
         11     -6.49002E-02   -5.81821E-02     4.71620E-02
          9      4.10091E-01    4.10201E-01     6.12380E-02
          8     -1.38020E-01   -1.38088E-01     5.22775E-02
          7      7.41781E-02    7.42711E-02     5.03853E-02
          6     -7.10254E-02   -7.10996E-02     6.31595E-02
          5      6.07915E-02    6.08549E-02     4.65711E-02
          4      4.04578E-02    4.04831E-02     5.29515E-02
          3      4.05203E-01    4.05175E-01     5.93174E-02

STEP NO.          13

ENTERED VARIABLE  13

   F-LEVEL                        .78893
   STD ERROR OF EST Y             .54873
   MULTIPLE CORRELATION           .85017
   R-SQUARED                      .72279
   DEGREES OF FREEDOM                151
   CONSTANT TERM                  .03218

      VARIABLE     BETA PRIME        BETA           SE(BETA)
         18      6.35007E-02    6.29605E-02     5.95387E-02
         17     -7.03754E-02   -5.23891E-02     5.19662E-02
         16     -5.79052E-02   -5.35626E-02     5.25754E-02
         15     -6.06270E-02   -5.37629E-02     5.14084E-02
         13      5.66358E-02    5.91152E-02     6.65548E-02
         11     -8.87691E-02   -7.95802E-02     5.29880E-02
          9      4.16501E-01    4.16612E-01     6.17042E-02
          8     -1.27079E-01   -1.27142E-01     5.37457E-02
          7      7.21164E-02    7.22069E-02     5.04738E-02
          6     -7.13932E-02   -7.14677E-02     6.32048E-02
          5      6.60518E-02    6.61207E-02     4.69791E-02
          4      3.73463E-02    3.73697E-02     5.31041E-02
          3      4.12978E-01    4.12949E-01     6.00004E-02
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STEP NO.            14

ENTERED VARIABLE  14

     F-LEVEL                              .40398
     STD ERROR OF EST Y                   .54982
     MULTIPLE CORRELATION                 .85061
     R-SQUARED                            .72354
     DEGREES OF FREEDOM                     150
     CONSTANT TERM                        .03943

       VARIABLE     BETA PRIME         BETA             SE(BETA)
          18      6.62316E-02      6.56681E-02      5.98084E-02
          17     -6.97553E-02     -5.19275E-02      5.20741E-02
          16     -5.81616E-02     -5.37998E-02      5.26808E-02
          15     -4.91564E-02     -4.35910E-02      5.39390E-02
          14      3.36336E-02      3.06278E-02      4.81873E-02
          13      5.33432E-02      5.56785E-02      6.69054E-02
          11     -9.42670E-02     -8.45090E-02      5.36562E-02
           9      4.19954E-01      4.20067E-01      6.20648E-02
           8     -1.23244E-01     -1.23305E-01      5.41894E-02
           7      7.47529E-02      7.48466E-02      5.07440E-02
           6     -7.06201E-02     -7.06938E-02      6.33416E-02
           5      6.58231E-02      6.58918E-02      4.70734E-02
           4      3.98516E-02      3.98765E-02      5.33552E-02
           3      4.10537E-01      4.10508E-01      6.02417E-02

STEP NO.            15

ENTERED VARIABLE    2

     F-LEVEL                              .41557
     STD ERROR OF EST Y                   .55089
     MULTIPLE CORRELATION                 .85106
     R-SQUARED                            .72431
     DEGREES OF FREEDOM                     149
     CONSTANT TERM                        .04295

       VARIABLE     BETA PRIME         BETA             SE(BETA)
          18      6.86789E-02      6.80946E-02      6.00434E-02
          17     -6.86905E-02     -5.11349E-02      5.21903E-02
          16     -5.32865E-02     -4.92903E-02      5.32452E-02
          15     -5.62925E-02     -4.99191E-02      5.49287E-02
          14      3.81185E-02      3.47119E-02      4.86954E-02
          13      5.24064E-02      5.47007E-02      6.70533E-02
          11     -9.19074E-02     -8.23937E-02      5.38611E-02
           9      4.11456E-01      4.11566E-01      6.35688E-02
           8     -1.18387E-01     -1.18445E-01      5.48162E-02
           7      7.19750E-02      7.20652E-02      5.10259E-02
           6     -6.72746E-02     -6.73448E-02      6.36776E-02
           5      6.86838E-02      6.87555E-02      4.73741E-02
           4      4.24226E-02      4.24492E-02      5.36082E-02
           3      4.17411E-01      4.17382E-01      6.12939E-02
           2     -3.04805E-02     -3.04036E-02      4.71633E-02
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STEP NO.           16

ENTERED VARIABLE  10

  F-LEVEL                               .05512
  STD ERROR OF EST Y                    .55265
  MULTIPLE CORRELATION                  .85112
  R-SQUARED                             .72441
  DEGREES OF FREEDOM                       148
  CONSTANT TERM                         .04214

    VARIABLE     BETA PRIME        BETA            SE(BETA)
       18       6.70679E-02     6.64973E-02      6.06177E-02
       17      -6.71086E-02    -4.99573E-02      5.25963E-02
       16      -5.33445E-02    -4.93440E-02      5.34153E-02
       15      -5.23200E-02    -4.63964E-02      5.71099E-02
       14       3.33319E-02     3.03530E-02      5.22596E-02
       13       5.03555E-02     5.25600E-02      6.78820E-02
       11      -9.40397E-02    -8.43053E-02      5.46427E-02
       10       1.44208E-02     1.34033E-02      5.70887E-02
        9       4.13304E-01     4.13415E-01      6.42555E-02
        8      -1.18758E-01    -1.18817E-01      5.50136E-02
        7       7.14060E-02     7.14955E-02      5.12459E-02
        6      -6.71546E-02    -6.72247E-02      6.38825E-02
        5       6.92200E-02     6.92922E-02      4.75800E-02
        4       4.12479E-02     4.12737E-02      5.40116E-02
        3       4.18014E-01     4.17985E-01      6.15428E-02
        2      -2.93762E-02    -2.93021E-02      4.75455E-02

STEP NO.           17

ENTERED VARIABLE  12

  F-LEVEL                               .00748
  STD ERROR OF EST Y                    .55451
  MULTIPLE CORRELATION                  .85113
  R-SQUARED                             .72442
  DEGREES OF FREEDOM                       147
  CONSTANT TERM                         .04232

    VARIABLE     BETA PRIME        BETA            SE(BETA)
       18       6.66372E-02     6.60703E-02      6.10220E-02
       17      -6.24196E-02    -4.64666E-02      6.64387E-02
       16      -5.35593E-02    -4.95426E-02      5.36446E-02
       15      -5.31149E-02    -4.71013E-02      5.78792E-02
       14       3.41540E-02     3.11017E-02      5.31455E-02
       13       4.86724E-02     5.08032E-02      7.10755E-02
       12       7.79218E-03     5.79645E-03      6.70232E-02
       11      -9.49715E-02    -8.51406E-02      5.56712E-02
       10       1.25415E-02     1.16566E-02      6.07372E-02
        9       4.12463E-01     4.12573E-01      6.52027E-02
        8      -1.18988E-01    -1.19047E-01      5.52632E-02
        7       7.14547E-02     7.15443E-02      5.14217E-02
        6      -6.62229E-02    -6.62921E-02      6.49987E-02
        5       6.94824E-02     6.95549E-02      4.78369E-02
        4       4.15577E-02     4.15838E-02      5.43120E-02
        3       4.18078E-01     4.18049E-01      6.17546E-02
        2      -2.95714E-02    -2.94968E-02      4.77589E-02
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